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THE GROWTH OF EXPORT TRADE.

The figures in detail of export trade for the month of May show that the foreign demand for American electrical apparatus has steadily increased throughout the year, although it may have varied from one month to another. The total export of heavy electrical machinery for the eleven months of 1905-6 has been $7,229,575, as compared with $6,661,676 in 1904-5, and $5,047,268 in the year 1903-4. In like manner the export has grown of electrical instruments and small apparatus. For the eleven months of 1905-6 it is no less than $6,115,254, as compared with $4,490,818 in 1904-5, and with $4,486,647 in 1903-4. It will be seen that the increase is quite large. The total export for the period named is $13,344,830, or nearly one and a quarter millions monthly. Moreover, this does not include copper wire, water wheels, steam engines, boilers, poles, steel towers, etc., required in many instances to complete the American electrical equipment for some plants in Mexico, South America, or the Far East. We shall soon have the figures for the complete year, but meantime those of our readers who are interested in export trade can take every encouragement from this proof that their exports have not been in vain but meet with steadily improving results.

230-VOLT AND 450-VOLT THREE-WIRE SYSTEM.

In the United States the 230-volt, three-wire system of low-tension distribution is the rule and the 450-volt, three-wire system the exception. Of the latter class there are only a few instances to be found in city lighting systems. In Europe, however, and particularly in Great Britain, the conditions are just the reverse. The 450-volt, three-wire system is the rule and the 230-volt, three-wire the exception. The contrast between the practice, in this respect, on the two sides of the North Atlantic Ocean is very remarkable. The 230-volt, three-wire system supplies 115-volt lamps on each side of the neutral conductor. The 450-volt, three-wire system supplies 225-volt lamps on each side of the neutral conductor. So that the essential difference between the two systems is that one employs 115-volt lamps and the other 225-volt lamps. Of course, it is possible to employ a multiple-series arrangement on a 450-volt, three-wire system and connect 115-volt lamps thereto in series pairs, so as to light two lamps where one lit before. But this arrangement is very rare. People do not seem to want to turn on or off two lamps simultaneously. They insist on the motto of the Three Musketeers, which paraphrased in this instance for lamps may read: one switch for all lamps and all switches for one. Moreover, there is a certain technical objection to wiring two lamps in series from the same branch, that if either breaks its filament the pressure across the gap becomes 225 volts, or double the normal pressure at lamp terminals. Sometimes this abnormal rise in pressure within a rupturing lamp makes things inside it so hot and oppressive that the lamp explodes. That is, lamps in series-parallel are more apt to explode when their filaments break than when connected in simple parallel arrangement.

Now, as everyone knows, the advantage of a 450-volt, three-wire system lies in its conductors, while the advantage of a 230-

volt, three-wire system lies in its lamps. The amount of copper required for a given distance of transmission and given load is inversely as the square of the voltage. Also, for a given density of lighting and size of conductors the economical radius of transmission is directly as the voltage. The commercial city range of transmission on the 450-volt system is about a mile around the central station; while, with the corresponding range, in cities of similar lighting density, it is only about half a mile on the 230-volt system. Consequently, there is a very manifest advantage in the 450-volt system either in economy of copper, or in radius of distribution or both. On the other hand, there has never yet been found a way to make a 200-volt lamp as good as a 100-volt lamp of the same candle-power and date of manufacture. It is possible to make a 200-volt, 32-cp lamp almost as good as a 100-volt, 16-cp lamp, because this merely means placing two of the latter in series in one and the same globe. Again, it is possible to make a 200-volt, 16-cp lamp almost as good as a 100-volt, 8-cp lamp, because again this merely means placing two of the latter in series in one and the same globe. But it is not possible to make a 200-volt, 16-cp lamp as good as a 100-volt, 16-cp lamp. If that were possible, it would mean that a 100-volt, 8-cp lamp was as good as a 100-volt, 16-cp lamp, and this has never yet been true. For one and the same voltage, the 8-cp lamps are inferior to the 16-cp lamps, and the 4-cp lamps still worse, and so on, as the filament becomes finer and more delicate. The disparity against the higher voltage lamps may be either in efficiency, or in life-time, or in both. There is no immediate prospect of escape from this seemingly blind alley of physical conditions. Besides, the high-voltage lamps cost more to make and to buy, anyway, which is adding insult to already existing grief.

The preference for a 450-volt or a 230-volt, three-wire system will depend in large measure upon whether the central station intends to sell light, or to sell power. In the United States it is customary in many large cities to sell light and grant free renewals of lamps, so that the demands of the lamp preponderate over the demand for economy in buried copper. In Europe it is just the reverse. It is the custom there for the central station to sell power only and each consumer provides his own lamps. The demand is for the cheapest lamps, nearly regardless of efficiency. Is it, therefore, to be wondered at that the European stations lay 450-volt networks? They would be glad to lay 900-volt networks if 450-volt lamps were purchaseable and municipal regulations permitted. The central station manager has in Europe only to supply amperes, on demand, at a voltage that is reasonably steady. Each consumer buys his lamps across the nearest bargain counter and everyone is happy. The difference is that high-efficiency lamps are but little known or understood in Europe. In fact, few believe that they exist outside of American technical journals. The consumers, therefore, consume electrical energy with healthy appetite. On the other hand, they use 8-cp lamps as standard, where we employ the 16-cp lamp as standard. They get along then with much less light, but consume more watts per candle. Again, the central station freed from lamps or lamp renewals, and aided by a saving in copper, can make both ends meet on a lower price for electric energy, and thus the cost of a candle-power-hour with low-efficiency lamps and a low cost per kilowatt-hour, is quite reasonable; so that our European neighbor does not need our pity. In fact he is often apt to offer his pity to us. International amity is never better served than when individual nations mutually exchange sympathy in this way. There is no immediate likelihood of the large American cities changing from 230 volts to 450 volts on their three-wire distributing networks. The change would involve replacing not only all the lamps on the system, but also many of the cut-outs, switches, fixtures and even wiring systems, which might not be able to support the increased pressure. Moreover, there is a curious incidental influence of the American low-tension system in fostering high-efficiency lamps. The recent development of the osmium, tantalum and tungsten filaments has been greatly retarded by the fact that these substances are metals and that it is very hard to make filaments of them with sufficient resistance to span even 100-volt mains, much less 200-volt mains. This means that the market for these metallic filament high-efficiency lamps is wider in the United States than it is in Europe. It would not be surprising, therefore, if the tantalum lamp or its congeners came into general use in America sooner than in Europe. It is an ill wind that blows nobody good.

The Struggle for High Voltage.

The brief paper by Mr. Wernicke, published elsewhere in our columns, is evidence of the pressing importance of high-voltage work all over the world. As the case stands to-day, the actual advance in the long-distance transmission of power depends absolutely upon improvements in line insulation. It is a noteworthy fact that the upper limit of working pressure to-day stands practically about where it was five years ago. Between 50,000 and 60,000 volts lies the present limit, and it is well known that a considerable proportion of plants rated at such figures are actually working some thousands of volts lower. Now for most cases there is no especial need of going even to 50,000 volts, since unless very large amounts of energy are transmitted, the wires at 50,000 volts and any ordinary percentage of drop come out too small for mechanical safety. But in case of great enterprises high voltage may become imperative, as in case of the Victoria Falls project, in which opportunity for commercial success seems entirely contingent upon transmission at a voltage in the neighborhood of 150,000. The larger value of many water powers now undeveloped will hinge entirely upon the use of pressure such as this, and experiments on the extension of practice in this direction are most important. It strikes us that such experiments as those described by Mr. Wernicke, albeit on a small scale, are very valuable by reason of their continuity of operation.

Practically every large electrical works and insulator factory has high-voltage apparatus for testing and uses it freely. Some experimental high-voltage lines have been worked successfully, but the one point covered in the Pankon tests, viz., continuity of operation, has generally been neglected. One really does not care much how well a 100,000-volt line can be made to work part of the time, the vital question being how well it will serve as a steady source of power. Hence, the longer a trial line and the more steadily it is worked, the nearer one comes to practical conditions. It is now fortunately a comparatively easy matter to design insulators for normal conditions of operation. The voltage which can be carried is not limited by the dielectric strength of the insulator, but by the striking distance from the edge of the upper petticoat, which when wet must be regarded as having a conducting upper surface down to the pin by the shortest route. The striking distance which corresponds to any given alternating-current voltage is pretty well known, and thus the dimensions of insulator for any given factor of safety. Thus an alternating-current pressure of 150,000 volts will flash between points a distance of 15 in., and an insulator for this pressure

must have a sparking distance from edge of upper petticoat, to pin of 15 in. for unity factor of safety. Since it is well established that line voltages may be at least doubled by resonance, surging and the like, it is safe to say that a sparking distance of 30 in. would be none too much for this voltage. Even this takes no account of the possible effects of weather mentioned in Mr. Wernicke's paper. Unless the petticoats are properly shaped it may happen that there will be so much surface wet that flashing over may be considerably encouraged.

Long-continued tests under severe weather conditions are necessary to a proper proof of the working factor of safety, and the best way to get these is to work a fairly long line out of doors. Spray tests are very well in their way, yet they fail to include the combined effects of dirt and weathering that are so active in causing line breakdowns. The universal experience upon power transmission lines is that the insulators may be tested before erection, and again *in situ* prior to putting the line in service without showing signs of weakness, and yet may be subject to severe breakage during the first season. If a few score insulators, however, could be operated at double normal voltage all through a winter, one would get a very clear notion of their weak and strong points. Such tests are, of course, on a rather large scale, but their cost need not be excessive. A score or two of poles rather closely spaced would give a fair length of line. Almost every electrical works has now alternating-current induction motors available in some of its buildings, and an alternating-current power plant. To get the necessary endurance test it would merely be necessary to set up a pair of high-voltage transformers to serve one of the regular motors via the transmission line, leaving the ordinary motor circuit ready to be cut in at short notice in case of failure. In this way by running every working day a very large amount of information could be gathered regarding the behavior of the insulators and their supports on a practical scale. It is just such information that is needed as a preliminary to the transmission work of the next few years. A few years ago the experiments at Telluride, carried out in just this practical spirit of inquiry, laid the foundations for the high-voltage work of to-day. The element of time enters into many electrical matters and particularly into problems of insulation. Tests neglecting this element are likely to give unreliable results, leading to a sense of security unjustified by the future. The more data one can get based on continuous work, the better.

"IMAGE CURRENT" ALTERNATORS.

If, when the rotor of an induction motor is revolving synchronously, direct current be introduced into the secondary windings, it will be found that the quadrature wattless component of the primary current decreases, and at a certain value of introduced secondary current, the wattless component of the primary current reduces to zero. A further increase in the secondary current causes the primary to draw from the supply system a leading wattless current; or briefly, the machine operates in all respects similarly to the well-known synchronous motor. If, under the conditions assumed, the mechanical torque on the rotor is increased, the machine takes a certain component of power current in the primary and operates as a true motor. If, however, the torque is decreased and reversed, the machine becomes a generator and will return power current to the supply system. A similar course of reasoning will show that if alternating current having a frequency corresponding to the slip of the rotor from synchronism be introduced into the secondary, such current may likewise serve to supply the magnetmotive force necessary to produce the field flux, and the machine again becomes a synchronous motor (or generator) at a speed less or greater than that corresponding to the revolving field according to whether the slip is positive or negative.

On page 94 of the present issue Mr. G. Faccioli gives an interesting description of an alternator which is excited by low frequency current according to the method outlined above. When the method is applied in its simplest form it is found that the load current in the primary circuit (the armature of the alternator) reacts directly on the secondary (the field of the alternator) and that additional current must flow in the secondary if the required magnetic field is to be maintained. This additional secondary current must be equal in magnetmotive force to the load current in the primary, but the volt-amperes represented by the current in the secondary is small, due to the low value of the slip frequency and the correspondingly low e.m.f. Thus the load current is accurately reflected in the exciting circuit, which fact accounts for the use of the term "image-current" alternators. When a synchronous alternator is excited by direct current the magnetomotive force of the field current is constant if the exciting voltage is constant, and the field flux varies with the change in value and electrical space position of the magnetomotive force of the armature current. Thus with a leading load current the field flux is increased, while a lagging load current decreases the field flux. With alternating-current excitation, however, the exciting generator possesses an inherent tendency to supply current of the proper value and phase position to maintain the field flux at the value demanded by the impressed voltage, quite independent of the reluctance of the field circuit or the opposing magnetomotive force of the armature current. It is to this transformer feature of the exciting circuit that the presence of the image current may be attributed.

As pointed out by Mr. Faccioli, the direction of the image current depends upon the sign of the slip; when the slip is positive the image current may be considered positive; a negative slip produces a negative image current. This fact leads to an extremely simple method of eliminating the image current from the low-frequency exciting generator, by causing a single exciter to supply current simultaneously to two equally loaded alternators, one operating at negative and the other at positive slip. Thus the image currents are confined locally to the secondary (field) circuits, and the size of the exciter is, therefore, reduced to the usual capacity. It is a curious fact that only the "power" components of the image currents tend to neutralize each other in the circuits from the exciter; the wattless components tend to add directly, so that their resultant sum must be supplied by the exciting generator. It will be recalled that exactly similar conditions would exist if the two alternators were of the usual synchronous type, excited by means of direct current, in which case, for constant field flux, the excitation magnetomotive force must be increased or decreased according to whether the wattless component of the load current is lagging or leading. It is interesting to note that the resistance drop in one armature winding is positive and that in the other negative, so that by properly proportioning these drops the resultant of the two may be negative if desired, and the potential regulation may be given any value required. It is difficult to determine to what extent these alternators will be more advantageous than the present machines, but the new method of exciting alternators is extremely interesting, and it will doubtless prove useful.

A Report on the Conditions of London Traffic.

The city of London, with the largest urban population in the world, some of the narrowest streets, and a tremendous passenger traffic, has necessarily a very deep interest in the improvements of its means of vehicular communication, and this interest is exemplified by the report of the Royal Commission on London traffic, the fourth volume of which has just been issued, being in reality the eighth and final one in the series. It contains a large amount of American evidence taken by the commissioners in the United States in 1903, from such men as Messrs. Wilgus, Barclay Parsons, Arnold, Vreeland, Winter, Rea, John B. Parsons, Bancroft, Sargeant, Winter, Twining, in the transportation field, and from a number of public officials whoes duties embrace the consideration of transportation problems.

A large amount of attention was given to the effect in America of trolley cars in reducing street congestion. There was a marked unanimity of opinion that a reduction of congestion of this kind follows, partly by giving direction to the other vehicles on the street, and partly by the fact that the cars carry the people in a more compact way than is otherwise possible. Mr. Vreeland's testimony on this point was especially complete, as he reviewed the history of Broadway from the time that the only transportation south of Fourteenth Street was done by omnibuses. At this period there would be times when there would be a mass of vehicles standing still from twenty to thirty minutes at a time, particularly at congested corners like Canal Street and Fulton Street, and many people claimed at that time that it would be impossible to operate a street railway on Broadway with any facility to the public. Some conception of the conditions of that period can now be obtained by observing traffic congestion at certain times of the year on Fifth Avenue, which is the only north and south avenue in the central section of New York City where there is no railway. In connection with this point the question arose as to the minimum space which should be allowed between the outside of the rails and the curb. Mr. Vreeland cited Fifty-ninth Street west of Columbus Avenue, where there is just enough room on each side of the track for an ordinary 5-ft. 2-in. vehicle to be passed by a car, but where a man driving a furniture van would have to put the wheels of the van over the curb if he wanted to stand still on the street to load or for any other purpose. Mr. Arnold, speaking of Chicago, gave the opinion that if there was room for one vehicle between the car and the curb with two tracks, the use of a double-track line would decrease congestion rather than increase it. General Bancroft, of Boston, referred to a street in Somerville only 45 ft. in width, in which the company had recently laid street railway tracks. Mr. Winter, of Brooklyn, directed attention to the fact that the introduction of a line of cars on a street tends to draw travelers from adjacent streets and so increases the liability to accident.

Another timely and pertinent point was the cost and utility, relatively, of subways and elevated roads. Mr. Twining estimated the construction of the Philadelphia four-track subway at about $500 per running foot, and the elevated railway in Philadelphia, exclusive of foundations and rails, but including stations, at about $40 per running foot. General Bancroft referred to the difficulties of subway construction in the streets of Boston on account of the crooked character which prevented securing high speed, while the elevated railway is outside of the congested district and straighter. The initial difficulty of noise with the elevated road has been largely reduced and the public were asking for extensions. Others, among them Mr. Arnold and Mr. Carson, called attention to the greater desirability, from the standpoint of the passenger, of the elevated railway, but Mr. Arnold concluded that under American conditions it often would be more expensive than a subway on account of payments for damages to abutting property.

The subject of suburban traffic also came up in various forms. Mr. Wilgus, of the New York Central, outlined ideal suburban transportation when possible. This is for local cars operating throughout suburban towns and villages to take up passengers along the route, and then join the express line where, consolidated into trains of the desired number of cars, they would pass at high speed to urban points of distribution, where, if desired, they can be again disintegrated into separate units so as to pass to different parts of the city over the local means of rapid transit. This is possible with the multiple-unit system. Mr. Rea, of the Pennsylvania system, differed somewhat from Mr. Wilgus, and did not think that the trunk lines in the neighborhood of large cities could handle strictly local traffic to advantage. He expected that the Pennsylvania tunnel in New York would soon be filled to its normal capacity with through trains. He also said that he did not believe that there should be stations within four or five miles of the terminal, as such traffic could well be left to local transit systems. The Pennsylvania Company's average rate for commuting riders out of Philadelphia is 0.7 cents per mile, so that for five miles the company gets only 3½ cents, whereas the average cost of putting passengers through the Broad Street Station is figured by the company at 3 cents, leaving only 0.5 cents to pay for the transportation. He said that when electric railway operation began around Philadelphia the company's Philadelphia-Washington line began to lose suburban travel heavily, but this had now come back, because the trolleys had induced dense building within the first few miles, while in the outer sections people had to use steam railroads.

The notes on the visit to the United States, contributed by Sir Dickson-Poynder called attention to the tremendous distribution of urban population secured through the highly-developed street railway systems of the country, and to the effect on land values and rents. He also referred to the increase in the amenities of life due to the street railway system. It not only encourages people to live in independent houses, but tends to widen social acquaintance and affords opportunity for those to attend places of entertainment and instruction of the best kind in the central parts of the city. In London, owing to the absence of such facilities, the suburban inhabitant is in the town, but not of it, and is practically debarred from many of the advantages of town life in the enjoyment of the higher class of entertainments offered by the West End. The report also instanced the increase in usefulness through access of the street railway to public parks, ball grounds and amusement resorts, and to the development of resorts owned by railway companies.

Such conclusions were summed up by Sir George C. T. Bartley numerically, emphasis being laid on the desirability of establishing some authority of great powers, subject only to the control of State Commissioners of the State itself. A universal small fare per journey and one class of carriage were approved. Subways were found essential in the centers of large cities, and the New York example was signalized. "As regards the cost, it would seem that much might be learned from New York. Here the great subway, costing nearly eight millions sterling, will really not add a penny to the burdens of the city. In America there is a strict limit to municipal indebtedness, which we have not in England, and these great works are carried on by a system of co-operation between private enterprise and the municipality which seems to be well worthy of imitation."

Some of the general conclusions are important and may be here noted in abstract:

1. In the cities visited, omnibuses have almost disappeared, and cabs are only used to a very limited extent.

2. For the ordinary means of locomotion, reliance is placed on surface tramways, elevated railways, and underground railways passing along "shallow" subways; all these are worked or are to be worked by electricity. The crowded streets of New York are practically as crowded and congested as similar streets in London, but the bulk of people are able to get along them with fair speed and comfort in the tramcars. The evils of crossing traffic is felt in New York as well as in London, and no means of overcoming the evil has been attempted, or, so far as we could learn, practically suggested. The obstructions caused in crowded streets by vehicles standing at the curbs are also as great, and equally beyond the power of the police authorities to cope with. The suburban rush at the usual morning

and evening hours is as great in New York as in London, and the problem of dealing with it is equally pressing.

3. Authority for the laying down of street tramways is now generally given by the municipal authorities, application to the legislature for sanction not being necessary. There is a marked tendency in the case of tramways towards amalgamation for operation purposes, and even towards the inclusion within such arrangements of both elevated and underground railways.

4. The elevated railways possess certain advantages as a mean of locomotion, but without going so far as to say that in no place and under no circumstances should an elevated railway be built, they are clearly not suited for London streets.

5. The "shallow" underground railway is preferred to the deep-level, and the latter style of railway will not be accepted unless when the former is out of the question. The "shallow" underground railway is likely to be largely used in the future, as the increase in traveling is such that the surface tramways alone, in many places, will be unable to carry the traffic without producing intolerable congestion. The "shallow" underground railway will be specially useful in forming a connection between different portions of the tramway system when the intervening streets do not admit of a satisfactory tramway service along them. The protection of the street traffic, and of the business of frontagers while such railways are being constructed, appears to be chiefly one of expense, but this is a question on which, in connection with London, the best engineering and expert opinion should be taken.

6. Valuable opinions have been obtained on the expediency of laying surface tramways in streets crowded with traffic. It seems obvious, however, that each case will have to be considered on its merits; the character of the street (whether residential or business, and the kind of business), the amount of traffic, its nature, the extent to which the passengers carried by other vehicles will be absorbed by the tramcars, and the possibility of heavy traffic finding an alternative route, being all important factors.

7. The tendency towards the amalgamation for operating purposes of urban tramways and railways, and the practical impossibility of rival tramways or railways being constructed when once the field has been occupied by such a combination, confirm the belief that competition through private ownership cannot be relied upon in such cases for the protection of the interests of the public. The owners of the amalgamated tramways and railways acquire a monopoly within the area which they serve, and it becomes essential that their tenure and management of their line should be subject to equitable regulations.

Public Ownership Discussion.

At Ithaca, on July 2, the social and economic section of the American Association for the Advancement of Science enjoyed an interesting session in Boardman Hall, Cornell University, several papers on the subject of municipal ownership of public utilities being presented before a large audience of distinguished sociologists and economists. The problem was treated from several different viewpoints. Charles Whiting Baker, of New York, spoke in favor of municipal ownership. Allen Ripley Foote, of Columbus, Ohio, urged a more careful public regulation of corporate control and H. T. Newcomb, of Washington, D. C., treated the subject from the wage earners' standpoint and challenged the opinion that the Government is the best employer. He said:

"In its efforts to convert municipal, State and national Governments to particular portions of its socialistic programme the persistent propaganda of public ownership, whose tireless activities so visibly pervade current American politics, usually demands the support of wage earners upon the ground that the employes of public enterprises will be more favorably treated than those of private enterprises in the same field. It is claimed that public ownership means higher wages, shorter hours of labor and, generally, better conditions of employment.

"The street corner socialist contends that private profits are the consequence of ruthless exploitation of workingmen, whose wrongs, now vainly crying for relief, would be transmuted into abundant blessings by the simple device of ousting the private capitalist and putting government in his place. The intelligence of his audience is not affronted by the absence of evidence that labor receives less than it creates, and the assumption that government ownership can create out of nothing something wherewith to pay more in wages for less in work and in product passes without audible challenge.

"And what is true of the avowed socialist and his leisure loving hearers is equally true of that numerous class composed of those who unwittingly support and advance the cause of socialism because their sympathies outrun their understanding. Government has been so frequently called the best employer that many have come to believe, in spite of easily available and abundant evidence to the contrary, that it is the best employer.

"This opinion, here and now, I challenge. I propose to prove not only that the Government is not the best employer, but that it is not even a fair employer. Nor is this all. I shall show conclusively that when Government engages in industry on a large scale the condition of its employes naturally and inevitably degenerates to that of slavery."

To prove that the Government is not the best employer, he quotes official statistics showing that from 1896 to 1904 the cost of living advanced 17 per cent, and that while in private employment the average wages per week advanced 12.76 per cent., in public employment there was no advance. He referred also to the restrictions placed on Federal office holders and employes in the curtailment of their political privileges by executive order.

American Society for Testing Materials.

A successful meeting of the American Society for Testing Materials was held at Atlantic City in conjunction, practically, with those of the Master Mechanics and Master Carbuilders. Dr. C. B. Dudley was elected president. Over 200 were present and a membership was shown of 835.

Mr. Maximilian Toch, New York, presented a report detailing a series of experiments on the electrolytic corrosion of structural steel, particularly grillage beams, supporting columns and base posts, which are either in the ground or surrounded by concrete and partly above the ground. The experiments proved to his satisfaction that electrolytic corrosion of structural steel embedded in concrete or sand takes place only at the anode, and there with great violence; further, that the cathode is protected by the electrical current. The popular impression that cement protects against all kinds of corrosion is fallacious. The anode not only rusts violently, but a molecular increase of volume may take place, which will split the concrete shell. Another conclusion arrived at was that electrolytic rusting of grillage beams of buildings need not be feared if the structural steel be protected by good insulating material, but the insulating medium should form a bond with concrete. The speaker suggested that if a large sheet of zinc could be buried in the ground and the zinc made anode and the building cathode it would probably be possible to corrode the zinc and save the steel of the building.

Professor Howe referred to the common practice of calling steel "steel," no matter how manufactured or to what purpose devoted. There is less difference, he said, between wrought iron and tube steel than between wrought iron and high carbon and spring steels. One danger in connection with this subject is that of relying on small scale experiments. This applies to the suggestion of using zinc at the foundation of buildings to prevent the corrosion of steel. Zinc would be extremely effective where electrolytic action was maintained over short distances, but it is a question whether it would be effective for long distances. It is a question also what would happen to the steel in buildings where zinc had been used in the way suggested, after the zinc had ceased to oxidize.

Mr. Cushman referred to experiments he had made illustrating the difference of potential between pieces of steel, presumably made under the same conditions. For example, he had taken two steel needles from the same package and by attaching to a galvanometer had established the fact of differing potential. If

such a difference exists between pieces of steel manufactured in the same way, how much greater differences of potential will be found in the various materials of a steel structure? It seemed impossible to him to consider any structure like a building as cathode. He therefore questioned the feasibility of employing zinc to prevent electrolytic action in the steel of a building. To him the question was not any more why wrought iron should differ from steel in susceptibility to corrosion, than why two steels differed greatly in rate of rusting. From the standpoint of electrolysis, the important consideration must be the amount and proportions of various impurities. Manganese affects electrical conductivity in a great degree. The chief need in connection with this subject is experimentation.

Rockefeller Hall of Physics at Cornell.

One of the more noteworthy features of the commencement exercises at Cornell University during the past week was the dedication of the Rockefeller Hall of Physics, the gift of Mr. John D. Rockefeller, which has just been completed at a cost of $250,000.

In the opening address, President J. G. Schurman, of Cornell, remarked that only a few years ago a single building, Franklin Hall, served for both the department of physics and that of chemistry. These departments soon outgrew their quarters and a new building, Morse Hall, was arranged for chemistry. This building was so named on account of the relation sustained by Mr. Cornell with Professor Morse in the development of the electric telegraph. For a time Franklin Hall sufficed for the Department of Physics, but within the past few years the congestion has been so great that it has been necessary to divide the classes in sections and to repeat several times the lectures delivered to the students. The necessity for enlarged space was laid before Mr. Rockefeller with the result that he caused the matter to be most thoroughly investigated. As a result he expressed his willingness to furnish the required funds and Cornell University has now excellent facilities for instruction and investigation in physics.

Professor E. L. Nichols, head of the Department of Physics, stated that the University now possesses the largest building on the continent devoted to the study of physics. Next year some 2,000 students will receive instruction in this building, which will require a teaching force of 26 men. This force has grown in numbers from two, Professors Anthony and Moler, who may well be said to have made physics at Cornell, beginning in the year 1872. As tangible evidence of the work of these men there still remains the first Gramme-ring dynamo made in America, exhibited at Philadelphia in 1876, and at other expositions, including the one at St. Louis in 1903. This machine was used for arc lighting on the campus before electric lamps were seen in the large cities. The current was transmitted through underground cables made by hand, and of which the insulation was shown to be perfect many years later. The course in electrical engineering which was given by Prof. Anthony was among the first undertaken on the eastern continent. In those early days physics appeared to be merely a highly developed science, but since then enormous strides have been made. They did not know yet if the end of progress had been reached, but it must eventually decline. If another such wave is to come, new and broader foundations must be laid, and it is the chief function of such a building as the Rockefeller Hall and the department which it contains to encourage research and investigation, and thus to minister to this need.

Professor William A. Anthony, who was expected to be present, was detained by ill health, but he sent a most interesting letter which outlined the difficulties connected with the beginning of physics at Cornell, where an opportunity was first obtained to practice on an extended scale his "hobby" to establish a physical laboratory where students should themselves perform the physical experiments and become familiar with the manipulation of the apparatus. He stated that a large quantity of apparatus was designed and constructed for the purpose of making tests of the performance of the old Gramme machine. From 1875 until 1887 this machine was used almost continuously by the students, and it furnished the means for a large amount of new physical experimentation. It also furnished current for the electric lanterns used in the physical lectures, as well as for numerous lecture experiments in electricity. The rapidity of the growth of the department of physics may be learned from the fact that the main physical lecture room in Franklin Hall, which was completed in 1883, was considered extravagantly large, although it would seat only 150 students, while in the new Rockefeller Hall one of the many lecture rooms is capable of seating 600 students.

Professor Elihu Thomson delivered an address treating of the relation of science to industry, in the course of which he said that there can be no conflict or incompatibility between study in pure science and in applied science. Both are of fundamental importance, equally necessary to progress in the broad sense. Industrial advance has in the past depended largely upon the prior results of laboratory work conducted oftentimes with meagre facilities or limited means. A growing appreciation of the value of such research to the industries, and the frequent urgent need of new data, are leading our larger manufacturing organizations to establish well-equipped research departments, including laboratories under skilled direction for the solution of problems and the ascertainment of needed but at the time unavailable information.

Many investigations of a physical nature, on account of their large scale and cost, have been, from necessity, only undertaken in connection with the particular industry concerned. This has been the case in the recent development of the steam turbine

ROCKEFELLER HALL OF PHYSICS.

engine, which has led to extended research into the many problems connected with steam at various pressures and temperatures, and the conditions for the most economical utilization of the contained energy. All of these are physical problems, and the research work in connection with them has already been of great engineering and industrial value. It is desirable that the laboratories of our technical schools should be able to take up similar problems, not alone for the value of the results, but for the training so given; the clear insight obtained and the accurate conception of the actions involved are invaluable for the student engineer.

"In the Welsbach mantle we have a striking illustration of the industrial value of special characteristics of certain comparatively rare metallic oxides. In like manner certain hitherto somewhat neglected metallic elements, on account of their high fusing points and remarkably low vapor tensions at high temperatures, give promise of effecting the revolution in incandescent electric lighting. The peculiar combined hardness and toughness of the diamond makes its artificial production for industrial uses a problem of great importance. No adequate substitute for it has been found.

"As emphasizing the relation of science and industry upon which we insist, it is noteworthy that the discovery and extraction of radium would have been impossible without the tons of residues rendered available in the industrial extraction of uranium. The few milligrams obtained from these residues by most patient and persistent effort also disclosed the possible existence, before unsuspected, of enormous stores of energy in the chemical atoms. A more effective co-operation between the research laboratories and those industrial establishments conducting operations on a large scale and with great resources is indicated. That nation which masters the confessedly difficult art of concentrating the efforts of its best minds upon social and economic problems will not only maintain itself, but constantly add to its prestige, its influence, its wealth. Likewise a con-

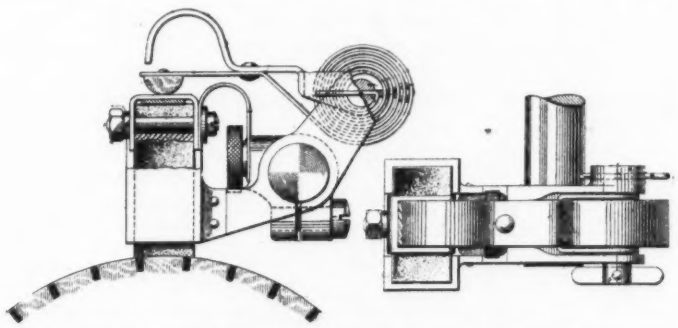
centration of its best talent upon the improvement of existing arts and industries, and to discoveries or advance work, must come to be regarded as most important to the general welfare worthy of every fostering effort. Let research be unrestricted by any utilitarian idea, let knowledge be sought out for its own sake, but let us also rejoice when knowledge can be made useful to humanity."

Following Professor Thomson's address, Professor W. H. Welch, president of the American Association for the Advancement to Science, presented a paper dealing with the relation of physics to medicine. He pointed out clearly the intimate relation which has always existed between these two important divisions of science. He instanced as examples physician, physic, physiology and other words which still persist in medical phraseology. Dr. Welch traced the historic relation of the two subjects and gave many illustrations of the debt owed by physics to medicine and by medicine to physics. He emphasized the necessity for research regardless of utilitarian features.

After the address by Dr. Welch, President Schurman declared the building permanently dedicated to the use of the Department of Physics.

Brush Holder.

The accompanying illustrations show a simple and compact form of brush holder for which a patent was granted to Messrs. R. Siegfried and N. W. Storer on June 26, 1906. The holder is so constructed as to obviate any heel-and-toe movement of the brush on the commutator during operation. The carbon brush, which makes a loose sliding fit in the socket portion, is provided at its outer end with a metal yoke which is clamped



FIGS. 1 AND 2.—SIDE ELEVATION AND PLAN VIEW OF BRUSH HOLDER.

to the brush by means of a bolt and nut. Upon the upper side of the yoke there bears a block which is riveted to the outer end of a coil spring. The movement of the free end of the spring is limited in all directions except circumferentially with the center of the coil spring as the center of motion, and consequently the tendency to heel-and-toe action between the face of the brush and the commutator cylinder, which tends to produce sparking, is avoided.

Dr. George Finzi.

Dr. George Finzi was born in Milan, Italy, in 1868. He early became interested in mathematical physics, and while still very young wrote a treatise on dynamo-electric machinery and for it obtained a prize offered by the Academie Pontaniana, Naples. With the intention of devoting his life to research work in pure science, he entered the University of Pavia in 1886, studying under the celebrated teacher of mathematical physics, Prof. Beltrami. Dr. Finzi graduated in 1891, the subject of his thesis being "The Variation of Hysteresis in Iron and Nickel," its text having special reference to the absence of the hysteresis loop when an alternating flux is superimposed. This work has lately been cited by Mr. Marconi, in his research on the magnetic detectors.

Shortly after graduation Dr. Finzi went to London, England, where he studied at the Hanover Square School of Electrical Engineering, passing examinations under Mr. Gilbert Knapp after a six-months' course. About August, 1893, he came to America where he traveled for some months, making many acquaintances among scientific authorities and prominent engineers. On his return to Milan he passed two years in experimental work, and then started the firm of Brioschi-Finzi Electrical Manufacturers.

The development of different types of generators and motors was first taken up, including a special type of motor for the Italian Navy, for which latter the new firm secured the order in an open competition. This motor was made entirely of laminated iron and copper, the only casting being a water-tight casing. It is of interest to note that the machine was rated at 4 hp at 1,000 r.p.m., had four poles and weighed complete only 250 lb.; it developed an efficiency of 86 per cent.

The idea of the alternating-current motor early occurred to Dr. Finzi and in 1896 he obtained excellent practical results with a single-phase motor, which was finally developed as a six-pole type and manufactured by the Brioschi-Finzi firm, with whom Dr. Finzi remained until 1905.

In 1902 the study of the multipolar commutator motor, with preventive resistances between the armature and commutator, together with a transformer having regulating taps in the secondary, was completed and the result embodied in a paper prepared for the Galileo Ferraris $3,000 prize. Owing, however, to a delicate patent situation, the paper was withdrawn. It is noteworthy that the motor here used was practically the same as

DR. GEORGE FINZI.

that made by Dr. Finzi for operation on a direct-current system, above referred to, having six poles divided in the center and high resistance commutator leads.

Dr. Finzi left the Brioschi-Finzi firm at the time of its amalgamation with the Gadda Company and shortly after the celebrated single-phase motor experiments on the Milan-Musocco Railway line and formed the Finzi Company of Electric Traction in 1903, where the results of these experiments were embodied in design. The Milan-Musocco experiments were conducted with a 30-hp, single-phase motor operating at 18 cycles and 600 volts line pressure stepped down by transformer on car to 120 volts. Elaborate and interesting data were obtained by operating on the Milan trolley system after nightfall with alternating current switched on the whole city network. Later the Valtellina designs for a large car were made, the results of which are exhibited in the Milan Railway Exhibition.

A special company was then formed with a capital of 1,500,000 francs. The Officine (Electro-Ferroviarie) for the manufacture of cars and traction material and the factory is now in course of construction near Milan. It will occupy twenty-two acres ground area, and is expected to be in operation by September, 1906.

Dr. Finzi's wide activities are shown by his patient work in aerial navigation. Considering the data on air resistance and

friction insufficient he has recently instituted a series of experiments with huge arms revolving on the top of a vertical milling machine, pressure at various points of different surfaces and solids being measured by manometers, and integrated afterwards. A recent elaborate paper on "Aero-dynamics," written in conjunction with Dr. Soldatti, secured a prize from the Milan Institute of Engineers and from the Milan Institute of Science and Letters.

CURRENT NEWS AND NOTES.

NEW YORK MUNICIPAL LIGHTING.—As the result of a report prepared by Chief Engineer Chandler Withington of the Finance Department, the New York City Board of Estimate has refused to appropriate $250,000 to pay the expenses of continuing the Mayor's special lighting commission on the theory that as conditions have changed in regard to the cost of lighting there is no further need to go ahead with the plans.

NIAGARA POWER HEATING.—Representatives of corporations interested in development of power at Niagara Falls were to have had a hearing before Secretary Taft at Washington on July 5 on the distribution of the waters of the Niagara River among rival power companies, but as several of the large corporations interested in Niagara Falls power development were not represented the hearing was postponed until Friday, July 13, when all the various interests are requested to submit their claims to the Secretary of War in writing.

MEETING OF CONTRACTORS.—The annual meeting of the National Electrical Contractors' Association will be held in Cleveland, Ohio, beginning July 18, when a very large gathering is expected from all over the country. A strong contingent is attending from New York City. Several trade and commercial topics of importance are up for discussion. According to Mr. Alex. Henderson, master of transportation, a new departure will be made this year in admitting entertainments of various kinds to the programme. Hitherto the conventions have been devoted solely to business of a serious character, without relief, but this year the members will relax and amuse themselves in a quiet way when the work is done.

CHICAGO PASSENGER TRAFFIC.—Under date of July 2 Mr. Bion J. Arnold has submitted to the committee on local transportation of the Chicago City Council a report relating to trolley, subway and underground conduit construction. Much of the subject has necessarily been treated in Mr. Arnold's earlier reports on the general subject. He recommends that the cable systems should be trolleyized, and that all feeder and transmission wires be placed underground within the business district and similar territory; also that the present surface systems be immediately rehabilitated and that steps be taken for an initial low-level subway system that he outlines, to cost between four and five million dollars. He also recommends that the river tunnels when reconstructed be done so at such a level and in such a manner that they can be used as part of a permanent and comprehensive subway system.

DEMAND FOR ELECTRICAL ENGINEERS.—The demand for engineers is well illustrated by the fact that all the students who were graduated from the college of engineering of the University of Wisconsin had secured positions before the close of the university year. So great was the demand this year that many of the students had two and three places open to them, between which to choose. All of the largest engineering companies in the country sent representatives to Madison to secure all available graduates. Of the 44 graduates in electrical engineering 10 entered the employ of the Chicago Telephone Company, in the engineering, construction and traffic departments; 5 went to the General Electric Company at Schenectady, N. Y.; 4 to the Wisconsin Telephone Company, Milwaukee; 3 to the Western Electric Company, Chicago, and the others to electrical plants in various parts of the country.

MUNICIPAL ELECTRICIANS.—Mr. F. P. Foster, secretary of the International Association of Municipal Electricians, announces the following partial list of assignments for the New Haven, Conn., meeting on August 15: "History of the Fire and Police Telegraph," Adam Bosch, Newark, N. J.; "Details of Certain Auxiliaries to Fire Alarm Apparatus," J. B. Yeakle, Baltimore, Md.; "Advisability of Protecting Municipal Electricians by the Civil Service Laws," Jerry Murphy, Cleveland, Ohio; "Comparison of Underground and Overhead Wiring and of the Relative Values of Single Rubber-Covered Wire and Lead-Encased Cable for Underground Construction," W. H. Thompson, Richmond, Va.; "Conditions Surrounding the Inspection of Wires in the Southwest (with special reference to the advisability of one inspector completing each inspection instead of several inspectors each doing a part of it)," Clarence R. George, Houston, Texas; "Question Box," Walter M. Petty, Rutherford, N. J.

ILLUMINATING ENGINEERING.—The New England Section of the Illuminating Engineering Society held its last regular meeting for the season in Boston, Tuesday evening, June 26, 1906. This was a question box meeting, the questions for discussion having been submitted by the members and printed previously to the meeting. A large number of questions were presented, but only a few could be taken up in the limited time. President Marks spoke on some particular applications of the semi-concealed methods of lighting, and described in detail a church where a very good illumination was obtained at a reasonable cost. Dr. Louis Bell commented on the colors of some of the common forms of illuminants, and also mentioned the commercial difficulties in obtaining good illumination. Mr. Cummings, of the Boston Consolidated Gas Company, spoke on the distribution curves of various lamps and the value of reflectors from a photometric point of view. Mr. Allen, of the General Electric Company, gave a brief description of some diffusing devices which are being used with good results in store and factory lighting. The subject of concealed lighting in halls, auditoriums, etc., was discussed freely by Messrs. Marks, Gardner, Cummings, Robinson and others.

ELECTRIC MICROSEISMOGRAPH.—The Meteorological Observatory of the St. Ignatius College at Cleveland, Ohio, of which Rev. Frederick L. Odenbach is director, has just issued its eleventh annual report containing a full description of an interesting electrical microseismograph. In this instrument, the earth tremors are taken up by electric contacts, and the transmission and recording of the seismograms are effected by electric appliances. It consists of two distinct parts: a pendulum, with its electric contacts placed in a vault below ground, and a recording device, which stands in the instrument room of the observatory in the sixth floor of the college tower. The pendulum has for its bob a cylinder of cast-iron weighing 115 pounds. At four points equally spaced around its circumference, corresponding to the N., E., S. and W. points of the compass, contact plates are secured on hard rubber plates. Opposite plates are joined by a wire which runs up to the recording device. The pendulum is so adjusted that each of four pointed cylinders of carbon, which are mounted solidly against the bottom of the vault, makes a slight but continuous contact with the corresponding plate on the pendulum cylinder. Each carbon is joined by wire to the recording device. When the adjustment has been properly made (unless there is a seismic disturbance), the pens of the recorder will follow a straight neutral line. The recorder is made up of the following principal parts: A delicate balance, a pair of magnets, a pair of coils and a pen; all this in duplicate for the N.-S. and E.-W. co-ordinates. The record is made on a continuously driven sheet of paper by means of pens which partake of the motion of the scale beams. The carbon contacts are in series with a battery and the coils of the electromagnets which control the movement of the scale beams, so that the slightest vibration of the carbons causes the pull on one side of a scale beam to be increased and that on the other to be decreased; and the movement of the pen is at once recorded on the paper. It is stated that the delicacy of the instrument is equal to that of the telephone or microphone, although the record allows of no direct conclusions regarding the amount of motion.

NEW JERSEY MUNICIPAL OWNERSHIP.—The law to enable municipalities in New Jersey to engage in the operation of lighting plants has gone into operation. It is said that efforts will be made by Camden and Morristown to secure plants of their own.

WIRELESS TELEGRAPH CONFERENCE.—The Berlin Foreign Office has been notified that the delegates of the United States to the international wireless telegraph conference, which will assemble in Berlin September 3, will be Ambassador Tower, Brig.-Gen. James Allen, Rear Admiral H. N. Manney and John I. Waterbury, of New York. Gen. Allen, Admiral Manney and Mr. Waterbury were nominated respectively by the Departments of War, Navy and Commerce.

FRANCHISE TAXES.—At Sacramento, Cal., both the Western Union and Postal Telegraph Companies have been assessed on their franchises, and both are making a fight before the local board of equalization on the ground that if Sacramento can enforce the payment of tax on franchises, every town, city and hamlet in the country where the companies have offices might do likewise. The Western Union is assessed $90,000, and the Postal for $35,000.

THE CZAR'S AUTOMOBILE.—According to advices from St. Petersburg, a large automobile ordered by the Russian Emperor has arrived at St. Petersburg and has been carefully examined by the Minister of Highways and Communications. The machine is bullet proof, has petrol tanks of great capacity and is intended to travel at a speed of 85 km. an hour. Grand Duke Michael has taken delivery of a 60-hp Brasier automobile. The coach work is exceptionally luxurious. The body is of mahogany and the interior is finished in blue morocco. It has two large arm chairs, which may be transformed into beds; a toilet outfit, a writing desk and a chest of drawers. Outside is an electric signaling apparatus, and the vehicle is equipped throughout with electric lamps.

STREET RAILWAY ASSOCIATION.—The proceedings of the twenty-fourth annual meeting of the American Street Railway Association—the last meeting held under that name—have just been issued in substantial book form by Prof. B. V. Swenson, the new secretary, from the New York office. The report runs a length of 452 pages, and has a portrait of President Caryl Ely as frontispiece, with a picture of Franklin, from the banquet menu, stamped on the back cover. A portrait of Past Secretary T. C. Penington adorns the text, with other illustrations. A good deal of the matter embodied in the volume is of permanent value. As our readers know, the name of the body under its new and comprehensive constitution is the American Street and Interurban Railway Association.

LIGHTING MAIL CARS.—Railway mail clerks secured the introduction by Representative Jenkins, of Wisconsin, chairman of the House Committee on Judiciary, of a resolution directing the Postmaster-General to notify the railroad companies carrying the mails that within a year from the approval of the resolution they will be required to furnish electrically-lighted cars for the transportation of the mails. As the mail cars are carried at the head of the train between the engine and coaches, whenever there is an accident or a collision the mail cars have to bear the brunt. There is then danger from escaping steam and the coal fires of the engines. Electricity would be safer for the clerks and for the mail, and consequently it is expected the resolution will be supported by the department as well as by the mail clerks' organization. No attack was possible at the last session of Congress, but it is expected that the matter will again be considered when the Legislature reconvenes.

WIRELESS ON PACIFIC.—The War Department announces that it has established and placed in operation a wireless telegraph station at Point Loma, near San Diego, Cal. Other stations will be opened later just as soon as the department is able to expend the appropriation of $65,000, which will shortly be available for the establishment of wireless stations on the Pacific Coast. The first contract to be let will be that of the station at Cape Flattery. Naval wireless stations on the Pacific Coast escaped injury during the earthquake and had the system of communication been perfected there would have been no such delay as occurred in the transmission of messages in and out of the stricken city. As it was, much valuable service was rendered in the early days of the disaster, as already noted in these columns. By the location of the U. S. S. *Chicago* at Fort Mason messages were received on board the ship and were communicated to the wireless station on Yerba Buena Island, and were thence sent to the outside world by the wireless outfit which had been erected by a youth in Oakland. The latter comes in for a generous share of official praise for the gratuitous service he appears to have rendered at a critical time during the trouble in San Francisco.

A TEXAS CENTRAL STATION SYNDICATE.—Syndicates and holding companies are getting to be common in the central station field of the United States. It is interesting to note that in Texas such centralized control is being worked out successfully on a number of plants in towns of 12,000 inhabitants and less. The Dallas Securities Company, of Dallas, Texas, of which J. F. Strickland, of Dallas, is president, controls a half dozen Texas central stations, all in cities of less than 12,000 inhabitants. The result is that the management of these companies is much better than is usually secured in such small towns. The Dallas Securities Company controls the electric light plants at Sherman, Hillsboro, Boham, Waxahachie, Dublin and Cleburne. Competent local managers are employed at each of these towns. Mr. R. B. Stichter, chief engineer, makes his headquarters at the general offices at Dallas, which is centrally located with regard to the various properties controlled by the company. The plants are too far apart to be interconnected electrically at present. The advantage of centralized control in this case lies chiefly in the better class of general supervision and management, which is possible, and the greater security of investment which covers several cities as compared with one which is dependent on local conditions in one town. There is also some advantage in having a complete set of testing instruments and a man expert in testing. The plan is to keep these testing instruments at one of the company's plants. When testing is to be done at another plant, these check instruments are sent with a reliable man to the place where they are wanted.

TELEGRAPHONE LINE 1,400 MILES LONG.—The Canadian Pacific Railroad has run a special copper wire between Montreal and Winnipeg, a distance of 1,430 miles, touching only Fort William and North Bay, for its telegraphone system, by means of which two messages—one by telephone and the other by telegraph—can be transmitted over the wire at the same time. A number of tests have been made at both Montreal and Winnipeg, and the operators at each end were able to converse with those at the other and in the meantime the operators at Fort William were sending a message by telegraph over the wire to Montreal, thus proving the success of the new system. It is claimed this is the greatest distance a human voice has ever been sent over such a circuit, but the Canadian Pacific Railroad officials think the wire will work just as well at a still greater distance. The introduction of a long-distance telephone in connection with a railway opens up great possibilities. It will be a boon to the heads of departments who wish to converse with other departments hundreds of miles away. It will eliminate the long "service" messages which so frequently tie up the wires. For the operating of trains it will be invaluable and will revolutionize the work of dispatchers. The company intends to install the system along all its lines as soon as possible. At the present time it is understood the company will have telephones installed in Fort William, North Bay, Montreal and Winnipeg, and there the officials will have to go when they want to talk, but it is the intention of the company to have the 'phones installed in all the principal offices at an early date. The company is now stringing a similar wire between Winnipeg and the Pacific Coast terminus at Vancouver.

MUNICIPAL NATURAL GAS.—According to the gas journals, the gas wells belonging to Lancaster, O., have given out and unless new ones are discovered or gas bought elsewhere the city will go out of the gas business. The price was 10 cents per 1,000 cu. ft. Last winter the city bought gas at 15 cents and sold it at 10 cents.

IN THE HARTZ MOUNTAINS.—U. S. Consul Albert, of Brunswick, Germany, writes that the Association for the Utilization of the Water Power in the Hartz Mountains has been organized and is about to begin work. Large dams will be built across valleys and the overflow water will not only be used for purposes of irrigation, but also for mechanical purposes, for mills, etc., and in generating electric power to be used on railroads, and for manufacturing. Persons interested can write for information to the Vorstand der Gesellschaft zur Förderung der Wasserwirtschaft im Harze, care of Doctor Stegemann, secretary of the Handelskammer, Brunswick, Germany, addressing him in the German language.

TELEPHONES IN SCHOOLS.—The board of education of Philadelphia has made a contract with the Bell telephone system of that city to place two telephones in every school, one in the principal's office and one in the hallway, for use of the children. In some schools there will be a telephone on each floor, and in the North East Manual Training School a private exchange with 18 instruments connected. This service will bring 32,000 residence telephones into direct availability for the 4,000 teachers and 168,000 pupils on the rolls. The exact number of new stations is not known, but will run into the hundreds. Aside from other uses, the check on truancy and kidnapping is regarded as warrant enough for this innovation. Such service is not unknown in other cities.

CHEAPER TO BUY.—At Peabody, Mass., the report of the Electrical Auditing Company, of Boston, has been presented to the special committee on electric lighting, showing that it is cheaper for the city to buy electrical energy than manufacture it. The old municipal plant is little better than scrap, and a new plant would cost $78,000. The best this could do would be to deliver electricity at the switchboard at 2.29 cents per kw-hour. The present cost with the existing plant is 3.69 cents, and the manager's own figure is 3.67. The town has had an offer of 2.25 cents, but it is believed that on a five-year contract this could be made 2 cents. It is possible that the town may remain in the lighting business on its own account, in spite of the larger outlay. The Electrical Auditing Company recommends the sale of the old plant, the purchase of electrical energy, the sale of power, and the adoption of modern business methods.

TELEPHONE MANNERS.—Note is made in the newspapers of a recent telephonic occurrence at Orange, N. J. A well-known resident there lay ill, and a change for the worse was noticed. On trying to use the party line telephone, a woman already talking refused to release the line a moment, although informed of the necessity for calling the doctor. Moreover, she insisted on retaining the wire so long that it soon became too late to reach the physician. We shall be glad to publish the woman's name. There is one little point in the matter that the newspapers overlook without comment. The family of the sick man had no telephone of their own, and the one they were trying to use was in a neighbor's house. In such an emergency they might be excused, but otherwise it would seem like so many other good people, they were in the habit of converting to their use property and service of the telephone system to which they had no right at all.

ENGLISH UNDERGROUND WIRES.—The British postmaster-general has written to the Association of Chambers of Commerce, which memorialized him in favor of laying all trunk wires underground to obviate delays of storms, as follows: "The underground line between London and Glasgow has now been completed. The spur line to Manchester has been continued through Bradford to Leeds. In the south an underground line has been laid from London eastward as far as Chatham and westward as far as Slough, and thence a pipe, but not yet a cable, as far as Reading. During the present year the postmaster-general hopes to extend this pipe line to Bristol and to provide a cable as far as Chippenham. The postmaster-general trusts that the Chamber of Commerce will see that such a programme evidences a desire to extend the underground system of telegraphs as rapidly as can reasonably be made." It is proposed to extend the underground wires to the landing places of important Atlantic and Mediterranean cables throughout Great Britain.

THE OPEN SHOP.—The National Metal Trades Association, employing about 150,000 men throughout the country, has issued a circular as to the reasons causing it to declare for the open shop. The statement says in part: "Since we as employers are responsible for the work turned out by our workmen we must have full discretion to designate the men we consider competent to perform the work and to determine the conditions under which that work shall be done, the question of the competency of the men being determined solely by us. While disavowing any intention to interfere with the proper functions of labor organizations, we will not submit to any interference with the management of our business. No discrimination will be made against any man because of his membership in any society or organization. Labor unions have limited, wherever they have been able, the employment of apprentices, and have carried this limitation to such an unreasonable extent that the country is suffering from a scarcity of mechanics, which will increase as the older mechanics die and the same restriction is continued."

CIVIC FEDERATION INQUIRY.—A special cable dispatch to the *New York Tribune* from London of June 30 says: "The American municipal experts have been seriously embarrassed by London hospitality in their efforts to complete the work of investigation of public and private ownership of gas, electric and tramway services. They have exchanged compliments with the Lord Mayor at the Mansion House, attended a series of luncheons and dinners, seen a wonderful display of diamonds at Stafford House, and are entertained to-day at a big garden party. Next week they will be entertained at luncheon at Dorchester House, and will be among the guests of the ambassador and also of the American Society on the Fourth of July. Their work suffers from social distractions, yet they are making fair progress with the examination of various private companies. They have been conferring on the subject of public and private ownership and the method of presenting the results of their studies in England, Ireland and Scotland, but have agreed to persevere in maintaining an attitude of reserve while they remain in the kingdom. Probably the tabulated results of their inquiry will supply both the advocates and the opponents of public ownership with ammunition for campaigning in America."

THE PUBLIC AND SCIENCE.—At the closing session of the American Association for the Advancement of Science last week at Cornell University in Barnes Hall. Dr. Andrew D. White, formerly president of Cornell University, described his first attendance at a meeting of the association, fifty years ago, in the summer of 1856, at Albany. The occasion was the opening of the Dudley Observatory, and was a general glorification of science. Such eminent men as Agassiz, Everett, Bancroft, Henry and Beard were the speakers. Dr. White said that when he was at Yale there was not a single student in his class of 109 members who had the slightest aspiration in a scientific direction, and he remembered how one morning, on seeing a student at a window in his room examining something in a test tube, he said to himself "What a futile occupation for a man with an alleged immortal soul!" The whole scientific apparatus of Yale in those days could be contained now in one of the smallest reception rooms at Cornell. Going afterward as a professor to the University of Michigan, Dr. White said he found that all the apparatus in the department of physics there could be put into an ordinary wardrobe. Dr. White said that he bases his optimism as to the future of this country largely on the part that scientific investigation is to have in solving the problems that arise in every department of government.

A 52,000 Horse-Power English Plant.

The discussion as to the ultimate huge power plants proposed for London would lead one to suppose that none of the existing plants were of even moderate size, from the American standpoint. But London has had stations of quite respectable capacity for some time past, and now in the new one of the County Council at Greenwich, has secured one of very large proportions, the full capacity when completed being not less than 52,000 hp. Greenwich is the historic ground, for electrical engineers, on which Ferranti did the early transmission work that looked so hazardous and uncertain, but now virtually all of the electrical energy from this new plant will be transmitted at 6,600 volts.

The energy from this large plant is to be supplied to the municipal trolley system through sub-stations, the 6,600-volt current, three-phase being delivered to rotary transformer sub-stations for conversion to 550-volt, direct current; the sub-stations being located now in several distant districts, while others are to be added. The Greenwich sub-station constitutes part of the main generating plant and is adjacent to the first portion of it that has now gone into operation.

The site is on the Thames at Greenwich, and was chosen, among other conisderations, for the facilities afforded in the economical transport of sea coal and the convenient supply of river water for condensing purposes. It covers approximately 3¾ acres, with frontages to the river of 240 ft., to Hoskins Street of 648 ft., and to Old Woolwich Road of 300 ft. The building is in two parts, the first of which is now completed; the second part is in progress, and is at present separated from the first by a temporary corrugated-iron screen. The complete structure will measure about 475 ft. by 195 ft., and about 80 ft. in height. The general arrangement of the station consists of a boiler house, engine room, offices, sub-station, workshop, pump and strainer houses, outside coal bunker, and a pier for unloading purposes. The ashes from the furnaces are removed by the conveyors on their return journey, and are shot into barges at the wharf. The steam is generated in 24 Stirling boilers and conveyed to the engines (four of which are erected in the first portion), giving a toal of 26,000 hp. The energy generated is passed to the switchboard galleries adjoining the engine room, and distributed to the various sub-stations. The sub-station for the particular section of tramways near the generating station adjoins the switchboard galleries.

At the northeast corner of the site a strainer house and pump house have been placed, and a partial supply of water has been obtained by an artesian boring into the chalk. The principal function of the pump house is to obtain a supply of water for condensing the steam after it has passed through the engines, the condensed water being used again for the production of steam. The water before entering the boilers is partially heated by economizers. There will be four chimney shafts. Those already erected rise to a height of 250 ft., with an internal diameter of 14 ft.

The construction of the superstructure is of a steel framework enclosed externally with brick walls, having Portland stone dressings. The foundation is a concrete raft 6 ft. in thickness, extending over that portion of the site covered by buildings. The roofs consist of steel principals carrying minor steel members which support a covering of coke breeze concrete, the exterior being slated. The interior wall facings are of white bricks with a brown glazed dado. The floors are of concrete and covered with terrazzo paving.

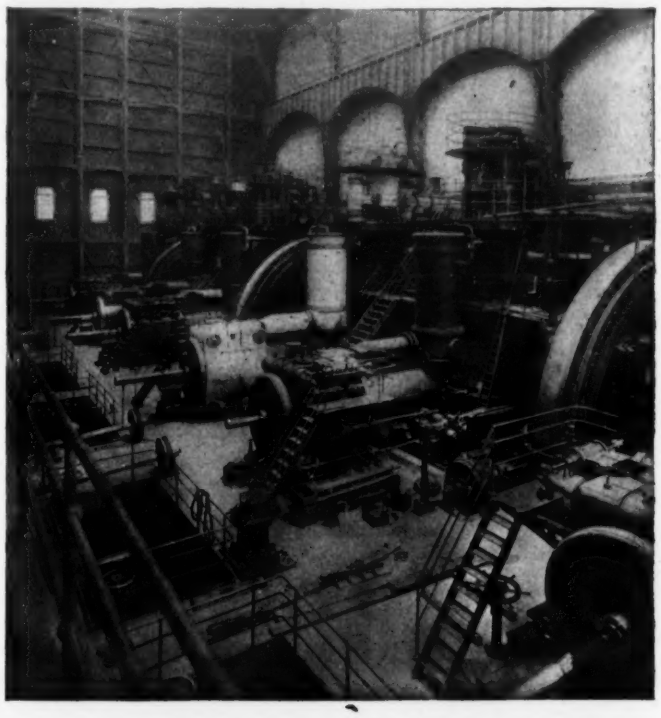


FIG. 2.—ENGINE ROOM OF GREENWICH POWER STATION.

The design of the complete station provides for eight steam generators and forty-eight boilers, but only half of the station is being built at the moment. The present portion contains machinery of the reciprocating engine type, and a total capacity of 14,000 kw, but it is proposed in the second portion to use turbo-

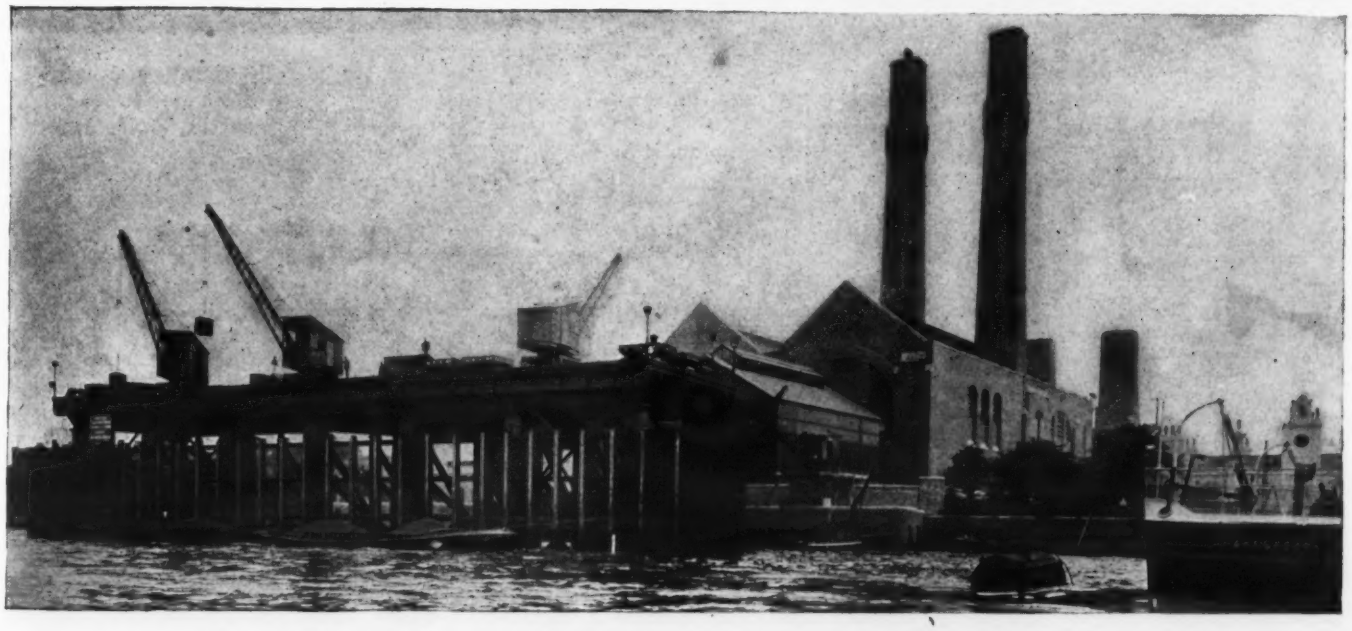


FIG. 1.—VIEW OF GREENWICH GENERATING STATION, SHOWING COAL AND UNLOADING PIER.

generators, with a total capacity of 20,000 kw, or 34,000 kw in all for the complete station.

The four generating sets are of 3,500 kw capacity each, with John Musgrave vertical-horizontal engines, each being two complete half engines, one on each side of the generator, consisting of a vertical high-pressure cylinder 33½ in. in diameter, and a horizontal cylinder, low-pressure, 66 in. in diameter. The stroke is 4 ft. in each case and the speed is 94 r.p.m., with steam at 180 lb. pressure. The generators were built by the Electric Construction Company, Ltd., of Wolverhampton, and are mounted directly on the engine shafts. They are all of the revolving-field type, and deliver three-phase currents at 6,600 volts between phases, at 25 complete cycles per second. The normal output is 3,500 kw or 306 amp. per phase, and 4,375 kw on emergency overload. The stators are star-wound, with the center point earthed. The coils are form wound and are laid in open slots. There are five slots per pole per phase. The magnets are built up of laminated steel stampings, secured in dove-detailed slots on the periphery of the fly-wheel. The coils are wound one layer deep, of bare copper tape on edge, and are held down by laminated pole tips. The excitation is at 125 volts, and each alternator has its own independent exciter driven by ropes from a pulley on the main shaft. In addition to the four main generators there are two independent direct-current steam sets, each of 150 kw capacity, which are used for lighting the station, a standby for excitation, and other uses. The engines are by Belliss & Morcom, Ltd., of Birmingham, of 250 hp each, running at 375 r.p.m. The generators are of 150 kw capacity and were built by Dick, Kerr & Co., Ltd.

The main switchgear is mounted on two galleries in the center of the long side of the engine room, farthest from the boilers. The oil switches are on the top gallery. The switchgear throughout is of the oil-break, remote-control, electrically-operated type,

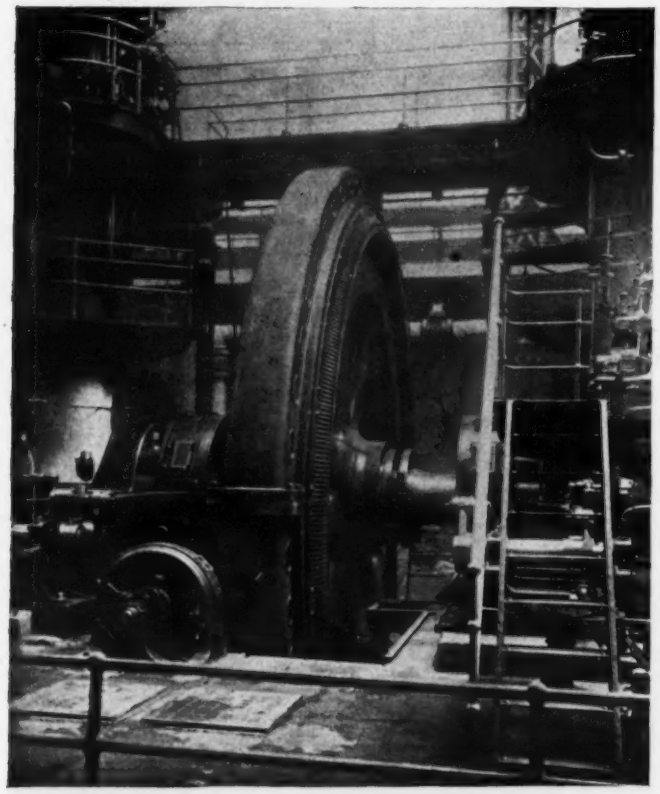


FIG. 3.—GENERAL VIEW OF ALTERNATOR.

and has been built by the British Westinghouse Electric & Manufacturing Company, Ltd. Provision is made for eight generators, and thirty-two feeders, and each generator is coupled directly to a section of four feeders. The various sections are connected by the main bus-bars, but when required the bus-bars can be easily disconnected, leaving the generators entirely on their own feeder sections. The oil switches are mounted on brickwork compartments, and the whole switch-gear equipment is arranged to be entirely fire-proof.

The operating table is on the lower gallery, and contains the small switches which control the main oil switches. The operation is carried out by direct current at 125 volts pressure, and the operator faces the engine room and the instrument panels when at his work. Immediately behind the operating desk is the auxiliary switchboard for controlling the station lighting, station motors, auxiliary machines and certain low-tension tramway

FIG. 4.—FIELD MAGNETS.

feeders, which supply the tracks in the neighborhood of the station.

The main cables between the generators and the switchgear and the street are carried in chases formed in the east wall. Each cable has its own separate chase, in which it is carried by means of clamps bolted to cast-iron bricks built into the brickwork. The feeders leave the station in two groups by means of two separate tunnels. One tunnel carries the cables for supplying the north of London, via the Blackwall Tunnel, and the other the cables for the south of London.

Adjoining the switchboard recess in a sub-station, which contains three Dick, Kerr & Co. motor-generators for supplying direct current to the local tramway lines and for station purposes. Each machine is of 500 kw capacity, runs at 300 r.p.m., and transforms the 6,600 volts, three-phase current to direct current at 500 volts. A battery of 280 Tudor accumulator cells is provided in the basement, close to the sub-station, for use in conjunction with the sub-station plan.

As mentioned above, the station is located advantageously with reference to the supply of fuel. Coal will be brought to the station by ocean steamers, holding up to 2,000 tons, which will lie at a specially constructed pier in the Thames. The coal will be unloaded by three electric cranes, with grabs, holding about 2,500 lb. each. The grabs will discharge into trucks on the pier, which, after passing over weighbridges, will discharge into a large steel bunker holding 200 tons. From this bunker the coal will be conveyed by gravity bucket conveyors to the bunkers immediately over the boilers. The object of using an outside bunker of this capacity was to enable a steamer to be unloaded in the shortest possible time without being dependent upon the comparatively slow rate of travel of an ordinary conveyor. The bucket conveyors are two in number, identical with each other, each having a capacity of 40 tons per hour. These have been erected by the New Conveyor Company, of Smethwick. On their return journey the buckets pass through a tunnel under the boiler house, and take the ashes from hoppers below the boilers, and carry them to a storage hopper under the pier, whence they are discharged into the barges.

Steam Turbine Station of Baltimore Electric Power Company.

By J. R. BIBBINS.

IN the new Gould Street power station of the Baltimore Electric Power Company may be found one of the most recent examples of modern central station design and equipment. With its installation of steam turbines, high vacuum condensing apparatus, high-pressure boilers, superheated steam and mechanically-driven stokers, it has proved very economical in operation, as shown by the data of the past year's operation, a subject reserved for subsequent treatment.

The system of the Baltimore Electric Power Company includes a central power station on the water front with high-tension transmission to the several distributing points in the city proper. Direct current is distributed by an underground cable network in the central business district, and alternating current is supplied for light and power in outlying manufacturing districts and residence sections.

The Gould Street station is located on tide water, close to the coaling docks of the B. & O. Railroad and the Western Maryland Railroad. It has a bunker storage capacity of 1,800 tons of coal, sufficient to operate the station at full load for thirty days. The small quantity of make-up water for the boilers is drawn from the city system, but a well is being driven for an auxiliary supply. The present generating capacity of the station is 6,000 kw.

In the design and operation of the plant the unit system has been carried out in detail from the coal supply to the switchboard and also, of course, on the transmission lines. Thus, there is a separate boiler and condenser plant complete in every detail for operating each of the two turbine units installed. Cross connections at various points between the two halves of the plant make possible effective inter-working either for operative convenience or in emergencies. A ring feed main, sectioned by valves, supplies each boiler from at least three sources. A similar ring main carrying saturated steam, later reduced to 100 lbs. pressure, insures a continuous supply of steam to auxiliaries, this ring main being fed from the downward saturated steam drum of the boilers. Pipe connections between the two main steam lines, between turbine exhausts and likewise between circulating water supply lines and dry vacuum pumps provide the necessary means for the inter-working of these parts of the plant.

In the electrical equipment duplication has also been carried out in a double set of busses with an equipment of electrically operated switches by which generator or line trouble may be generally isolated without disturbing continuity of supply.

The power station is thoroughly fireproof, having a structural steel framework, with concrete or brick walls. Reinforced concrete is used in the roof, main and gallery floors. Large window areas with balanced pivot sash provide the necessary light and ventilation which are so often curtailed even in costly power plants. The piping deck above the boilers is supplied with a double row of windows which provide ready exit for the heat radiated from boiler settings and piping. Simple but substantial iron stairs, railings and galleries have been provided throughout the building for access between decks and to otherwise inaccessible parts of the building or valves. Arc lamps illuminate the main areas, while incandescent lamps are located in dark places, such as condenser pits, ash gallery, etc. All the wiring is permanently run in loricated iron conduit and junction boxes. A 40-ton 4-motor Niles traveling crane spans the engine room.

STEAM TURBINE PLANT.

The compactness of the two turbine generating units has made it possible to provide pits in the center of the turbine room between the turbines so that all auxiliaries serving the turbines are directly under the eye of the chief operator. Conforming with late practice, the condensers, which are of the surface type, are installed directly beneath the turbines in the foundation pier which is cut away to receive them. The turbine bed plate, of itself a strong girder construction, is reinforced at the opening by I-beams spanning the condenser pit. Each turbine unit is thus supported simply by three concrete piers under the three respective bearings, all footing on "hard pan."

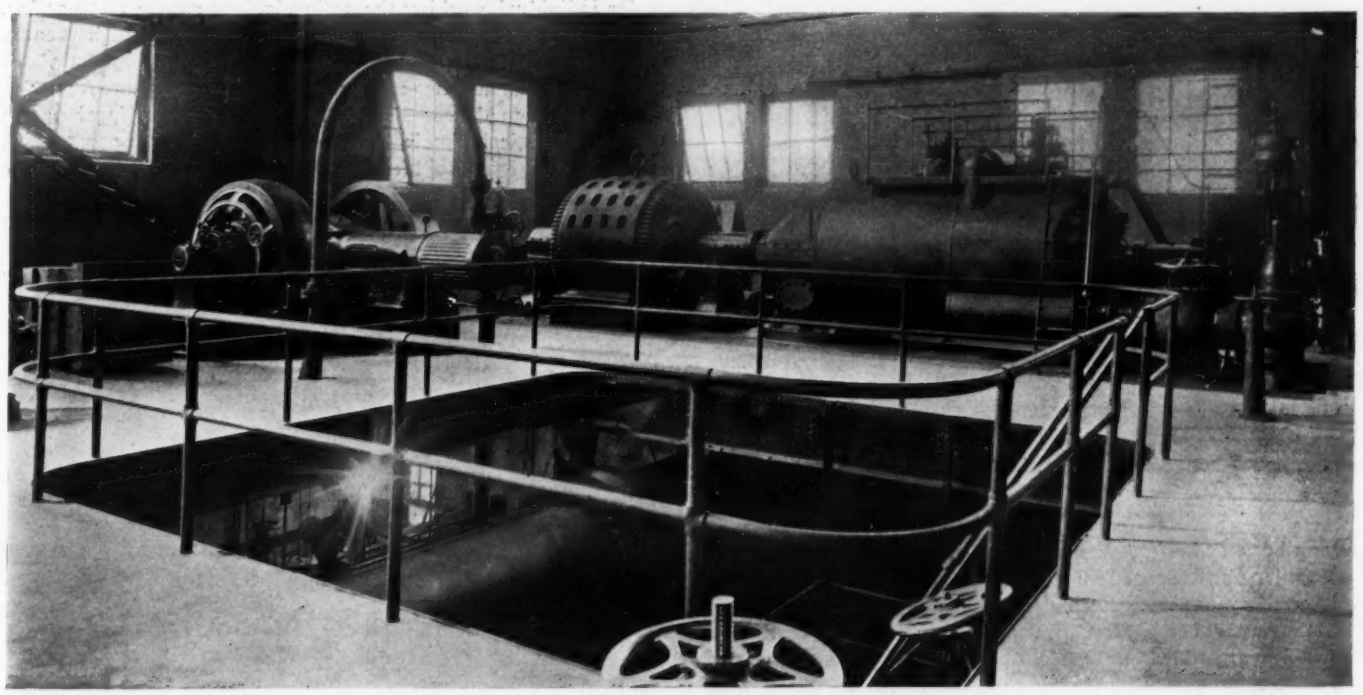


FIG. 1.—GENERAL VIEW OF TURBINE ROOM.

The turbines are of the Westinghouse-Parsons type, and the generators of the revolving-field, three-phase turbo type, driven through flexible steel couplings. Both conform to standard Westinghouse construction. Each part of the unit can be dismantled without disturbing the other, which with the assistance of the cranes becomes a comparatively simple matter. Independent low-head oiling systems are as usual employed for each unit with direct geared pump.

Each turbine has an overload capacity of easily 50 per cent through provision of a secondary admission valve controlled by the governor in the same manner as the primary valve. In ordinary operation the governor spring is set for mean load, but as a small speed variation is necessary, division of load of the two machines when in parallel is accomplished by a small speeder mechanism operating as a detent upon the governor. Being elec-

trically operated from the switchboard gallery, this speeder provides complete control of the generating system from the operating gallery. A safety stop of the centrifugal type at the end of each turbine shaft insures against destructive over-speeds, as it will instantly shut off steam supply when a predetermined over-speed is reached. During shop tests the turbines have shown the excellent results indicated in the accompanying table.

EFFICIENCY TEST OF 2,000-K.W. STEAM TURBINE, WESTINGHOUSE-PARSONS TYPE.

	Turbine No. 153.			
Approximate Load.	1¼ Load.	Full Load.	Half Load.	Remarks.
Brake horse-power.....	3,408.7	2,696.6	1,340.8	Speed variation zero to full load, 2.4%.
% Rated load.....	120.7	106	47.5	
Throttle pressure (Gage).	138.8	144.4	152.2	
Superheat (Deg. F.).....	11.23	9.5	2.6	
Vacuum (Ref. 30-in. bar).	26.59	27.05	27.03	To overload 2.8%.
Speed (R. P. M.).....	1,166.6	1,187	1,196.9	
Water per hour.....	45,023	35,456	20,948	Safety stop released at 11.8% above normal speed.
Water per B.H.P. hour...	13.21	13.15	15.62	
Generator Efficiency*....	95.5	95.25	92	
Water per K. W. H....	18.55	18.5	22.8	

*Including iron and copper losses only.

ELECTRICAL PLANT.

Of the accompanying illustrations, Fig. 1 is a general view of the turbine room, and Fig. 5 a view with the exciter units and battery booster in the foreground. This, however, also shows the auxiliary storage battery on an upper floor or crane deck. Fig. 2 is a general view of the switchboards. The main control pedestals are at the right, the main switchboard in the rear and

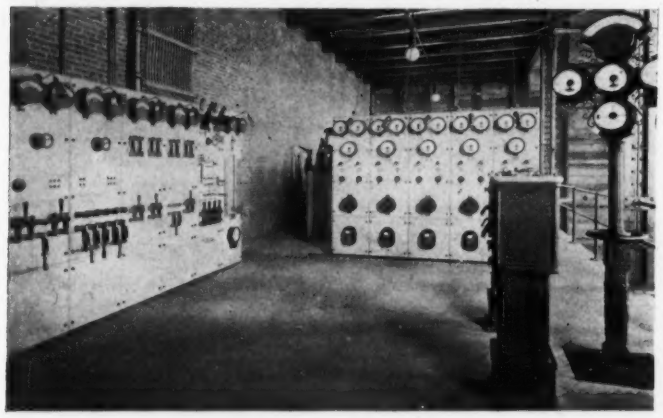


FIG. 2.—GENERAL VIEW OF SWITCHBOARDS.

the auxiliary switchboards at the left. The last two panels on the auxiliary switchboard show the end cell control for the exciter auxiliary battery. Figs. 3 and 4 show the main bus structure, the latter being an end view. In Fig. 4 the battery or oil switches are shown on the floor above. The three small control boards at the side of the building column in the foreground are for operating the motor-driven valves in the main condensing system.

Electrical control of both generating and distributing system is entirely accomplished from one point in the first gallery so located that the entire plant is under the eye of the operating electrician. Instead of the usual switchboard, each generator has an independent pedestal board. A third pedestal carries bus meters, this one being rotatable for greater convenience in reading the meters according to the light and position of the operator. On each machine pedestal are the machine meters, main switches, rheostat and speeder regulators.

The main control of the exciter system is confined to a separate switchboard of the usual low-tension type, upon which are also mounted end cell switch connections for the storage battery which is at all times kept floating on the exciter bus. Two exciter generators are provided, one of which is engine driven and the other motor driven. Outgoing feeder panels occupy another and separate board with a complete equipment of indicating meters, electrically operated switches and time limit relays which latter are ordinarily set at one second. Fireproof compartments, built of molded concrete blocks, effectively isolate the numerous high-tension switches, fuses and busses. These blocks, which are a novelty in high tension switchboard construction, were made by the National Hydraulic Stone Co., being molded under heavy hydraulic presses and form a very dense and fireproof material.

Instead of being located in the basement as is usually the case, the storage battery occupies the greater part of the second switchboard gallery. This battery is regularly charged once a week (on Sundays) by a small motor driven booster with all the end cells in circuit. The effectiveness of the booster has been thoroughly demonstrated from recording voltmeter readings.

CONDENSING PLANT.

In all steam power plants as short an exhaust connection as possible is desired between engine and condenser. This is here readily obtained by placing the condenser directly beneath and at right angles to the turbine. As the counter-current type of Alberger condenser usually takes steam at the bottom, a special exhaust nozzle was designed for this plant which provides room in the exhaust downtake not only for a gate valve, but also for a cross connecting pipe between the two equipments, so as to provide, as above noted, inter-working between condenser and turbine equipments in case of necessity. Both these large gate valves, as well as that in the cross connecting pipe, are motor-driven and controlled from small switchboards on the main floor near the turbine throttles.

The condenser capacity is such that if one is out of commission the other can readily handle the steam from both turbine units. Under individual working the rating is four square feet per kw, or working together two square feet per kw. Very high vacuum is obtained when running independently, within 1 or 1½ in. of the barometer. Standard two-stage rotative dry vacuum pumps remove air from the condenser shell, and a pair of centrifugal pumps driven by vertical simple engines supply cooling water, which is led to and from cold and hot well respectively by concrete ducts extending down to the water front. To prevent the return of hot discharge water a wing wall has been built out into the harbor for a distance of several hundred feet.

As there is a lift of eight or ten feet at the pumps and twelve at the condenser inlet, the circulating system has to be primed in

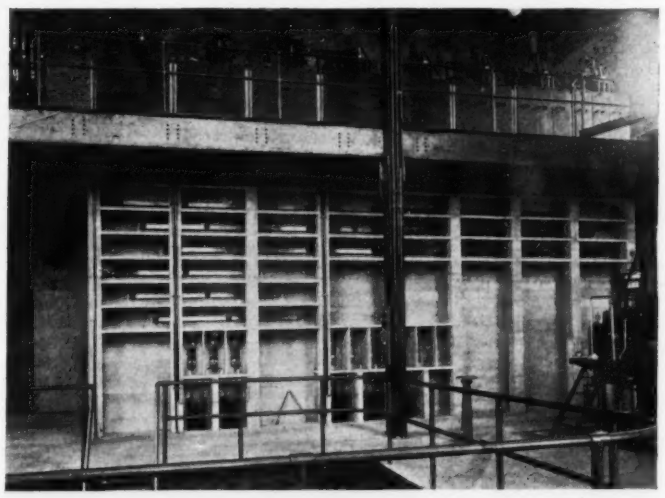


FIG. 3.—VIEW OF MAIN BUS STRUCTURE.

starting. This is very easily accomplished by a pipe loop, carried to the height of 35 ft. inside one of the building columns, which establishes connection between the top of condenser shell and water heads respectively. By first starting the dry air pumps the vacuum obtained is sufficient to pull the circulating water through the pump and into the condenser. The syphon effect is then established and the circulating pumps simply work against friction head. This method has many advantages over that frequently employed of connecting the pipe loop directly between air pump and circulating water line. In this case it frequently occurs that a dangerous quantity of water is carried over the loop in the form of spray to the air pump, whereas with the condenser connection the condenser operates as a separator of great volume and prevents such action.

BOILER PLANT.

In the boiler plant, the designer has not confined himself to usual operating conditions, but has equipped the plant for a

pressure of 200 lbs. and a superheat of 200° Fahr. To furnish this superheat the water heating surface of the boilers is augmented about ⅓ by a range of internal superheater tubes forming the second pass in the Stirling boiler. These may be flooded at any time, by which the evaporative capacity is increased.

Face couplings on the driving shaft of the Roney mechanical stokers provide for driving of an entire row of stokers by one engine. Each battery, however, has an extra driving engine for greater security against stoppages. The stokers deliver the ashes to concrete ash pits beneath, which in turn empty into dump cars running along the boiler room subway to the end of the building. At this point an electric hoist elevates the ashes to the ground floor where they are at present wheeled out by hand for the purpose of reclaiming some low ground in the vicinity of the power house.

The coal handling equipment ordinarily receives run-of-mine coal from hopper cars on the siding. Crushing this to a uniform size, it elevates the coal by means of a skip hoist into a tower, dumping into a hopper, which in turn discharges into delivery cars. These are operated on a motor-driven cable railway. As each car is check-weighed, it is run into the storage house and automatically dumped at any desired point. About 35 tons per hour can be handled by this method. Dropping from the bunker into the stoker chutes, the coal is again weighed as it is drawn out for each individual boiler so that a check is not only obtained upon the coal consumption of the entire plant at the tower, but the working of the individual boilers is more readily kept track of. With hot water meters in duplicate in the feed line a running check upon the water consumption is possible. It thus becomes a simple matter to conduct periodical efficiency tests upon the entire steam equipment. The bunker supporting structure is independent of boiler settings and also carries the weight of the upper boiler drums. By staggering the beams

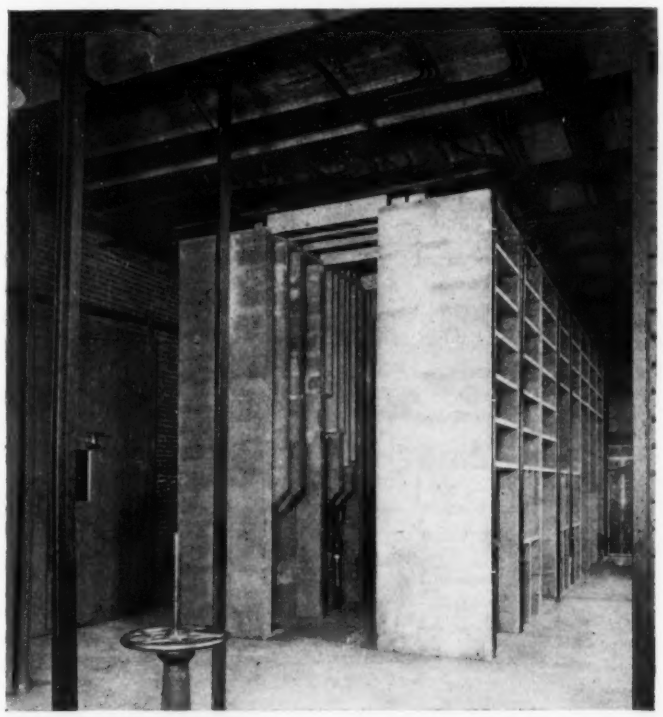


FIG. 4.—END VIEW OF BUS STRUCTURE.

forming the inclined bottom of the bunker, V-shaped pockets are obtained, tending to segregate the stock coal and assist its descent into the several corresponding chutes. All structural work exposed to the heat from possible spontaneous combustion in the bunker is heavily protected by concrete.

All high pressure steam piping is suspended flexibly by spring hangers with expansion and contraction provided for by long radius pipe bends. Although it is intended to use superheated steam, large separators have been installed in the basement for the protection of the turbines when running under saturated steam. The entire live steam system is drained by a Holly steam loop system. Draft is furnished by two independent chimneys, the smaller one serving a single row of boilers, the larger the remaining row. This latter, however, is designed to serve an additional row of boilers when such additions to the plant shall be deemed necessary. Damper regulators near the stack intakes assist the firemen in maintaining uniform pressure.

The station was designed by Mr. James B. Scott, designing and

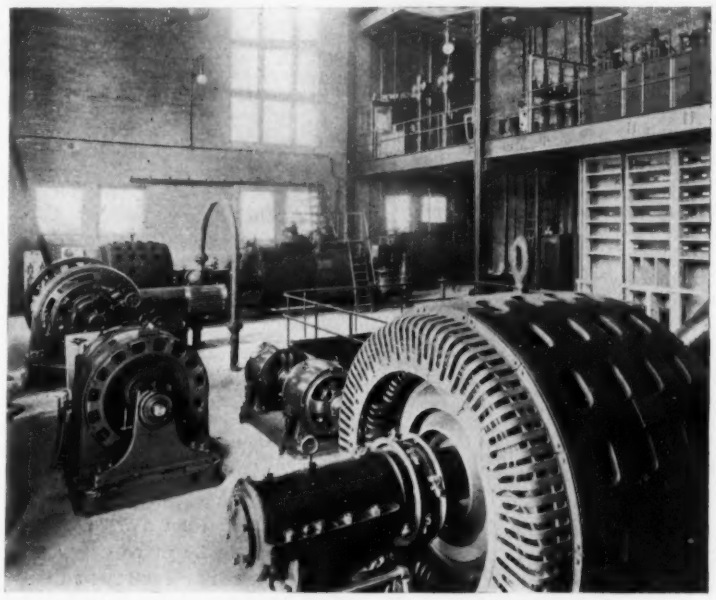


FIG. 5.—GENERAL VIEW OF TURBINE ROOM.

constructing engineer of the company, and built by the Eastern Electric Construction Company, a corporation financially allied with the Baltimore Electric Power Company and the Maryland Telephone Company.

Courtesies From the Italian Engineers.

By C. T. WILKINSON.

Members of the American Institute of Electrical Engineers who were unable to accept the invitation of the Italian Institute of Electrical Engineers, to visit Italy this summer and study the developments of electrical engineering, as shown by the exhibition at Milan and by the power stations and manufacturing companies of Northern Italy, missed a trip full of interest. The Italian Institute, disappointed in the numbers of American visitors, concentrated their attentions and courtesies on their old friend, Mr. J. W. Lieb. A dinner to Mr. and Mrs. Lieb by the members of the Edison Company of Milan, and numerous friends is of interest, at least from the prominence of those present. The speakers included Senatore Giuseppe Colombo, late president of the Italian Parliament, and first president of the Edison Company of Milan, who recalled his visit to New York years ago to consult with Mr. Edison with regard to the installation of his system in Italy and his return with Mr. Lieb. He also traced the development of the system in Milan under Mr. Lieb and recalled the strenuous early days of the company, and the Jumbo dynamos, which were working until quite recently. Mr. Lieb was the teacher of many of the now prominent engineers of northern Italy, and they owed him a great debt.

Mr. Lieb, in a brief reply, referred to some of the pleasant and humorous occurrences during his connection with Italian engineering and expressed great pleasure at the technical progress of Italy.

Sig. Brunialti, president of the Bank of Italy, spoke in the name of those who were present in America at the St. Louis Convention and referred to the many courtesies received by the Institution from their American colleagues. Sig. Barzano, another member of the Italian party to the St. Louis Convention, and a prominent patent lawyer and consulting engineer, expressed thanks to Mr. Lieb for the special courtesies received from him personally. Mr. Guido Semenza, secretary of the

Italian Institute, in a witty speech, regretted that other members had not accompanied Mr. Lieb, but expressed a desire to arrange an exhibition every year if it would bring Mr. Lieb. On all sides regrets were heard at the non-appearance of a large American party. Other prominent people present were Sig. De Andreis, member of the Italian Parliament; Mr. Esterle, general manager of the Edison Company; the Pirelli brothers, Mr. Rubini, director of Siemens & Halske Italian branch.

The next evening, June 1, a lecture was delivered by Mr. Lieb before the Italian Institute of Electrical Engineers on American developments in the generation and distribution of current for lighting and power. The lecture consisted of a detailed description of central station supply in large American cities with particular references to the work of the New York Edison. The lecture was followed by the presentation of a handsome picture of Mr. Edison to the Italian Society from Mr. Lieb, the picture being autographed by Mr. Edison and dated April 26, 1906.

Series-Parallel Armature Windings with Equipotential Connections.—I.

By Prof. E. Arnold.

LARGE multipolar machines should, when possible, have a bar winding, as the construction of a bar winding is simpler and mechanically more satisfactory than a wire winding. Moreover, the individual conductors can be more carefully and better insulated and are more easily accessible for repair than wire coils. Besides, less space is required for the insulation of few thick bars than for many wires of small cross-section, and in consequence the machine can be made smaller.

The current in one armature path is, if $2a$ denote the total number of armature paths, and I_a the total current of the machine,

$$i_a = \frac{I_a}{2a}.$$

For a bar winding, i_a should be somewhat larger than 60 and smaller than 200 amp.; if possible it is better to make i_a larger than 100 amp. in order to get good dimensions for the cross-section of the bars.

It may occur, however, that the current in one armature path of a machine with a given number of poles, and provided with lap winding is too small and the number of wires too great to use bars for the winding.

If an attempt is made to use a series winding (which has only two armature paths) too large a current is obtained for each path, and there are correspondingly too few commutator segments. In such a case the difficulty can be solved by using a series-parallel winding, which has a number of armature paths greater than 2, but less than $2p$.

The series-parallel winding has, therefore, the advantage that the number of armature paths can be made equal to any desired multiple of 2 independently of the number of poles, and in all cases a cross-section for the conductors can be chosen which is favorable for the designing of the machine.

In the design of series-parallel windings, as in all other windings, the greatest care must be taken that the armature paths are all symmetrical.

It is necessary, in order to obtain a perfect symmetry of all the armature paths, (1) that each armature path has the same number of coils, i. e., $\frac{s}{2a}$ (s = number of conductors) must be a whole number; (2) the number of brush sets must be $2p$.

It is always possible to fulfil both of these conditions. The first condition is fulfilled, for singly-closed windings, when $\frac{p}{a}$ is a whole number. If $\frac{p}{a}$ is not a whole number, the winding must be so many times closed that $\frac{p}{a}$ for each separate winding is a whole number.

For example:

For $p = 4$, $a = 2$, singly-closed.
" $p = 4$, $a = 3$, triply- "
" $p = 6$, $a = 3$, singly- "
" $p = 6$, $a = 4$, doubly- "
" $p = 6$, $a = 6$, singly- "
" $p = 10$, $a = 3$, triply- "
" $p = 12$, $a = 8$, doubly- "
" $p = 12$, $a = 9$, triply- "

The author first used the series-parallel winding in the Oerlikon Works in 1891 for four-pole and six-pole machines, and since then the following firms in particular have constructed many large multipolar machines with series-parallel windings and equipotential connections, which have given excellent results, viz.: Felten & Guilleaume-Lahmeyerwerke, Frankfurt; Allgemeine Elektrizitäts-Gesellschaft, Berlin; Sachsenwerke, Dresden; Vereinigte Elektrizitäts-Aktiengesellschaft, Wien; Atéliers de Constructions Electriques, Charleroi, and others.

The experience which has thus been obtained will be here considered. An incorrect choice of the proportions can lead to unsatisfactory working of the machine, and it is, therefore, important to understand the rules which are necessary for the design of these windings.

Experience has shown that series-parallel windings must be provided with equipotential connections (English patent 11,857, 1901; U. S. A. patent 783,498, 1905). There have been, indeed, many machines built with series-parallel windings which work well without these connections; they are, however, very sensitive as regards the position of the brushes. The experience has also been made that such machines, although they may, when in the testing room and also for some considerable time in position, run sparklessly, yet they begin later on unexpectedly and without apparent cause to spark; on the other hand, many machines continue to operate satisfactorily if the brushes and commutator are very carefully attended to.

In many cases equipotential connections have been added later, and, in so far as the proportions of the machine are favorable, always with good and often with surprising success. Machines which on account of heating of the commutator sparked increasingly, so that they had to be shut down after half an hour, have run continuously without sparking when provided with equipotential connections.

There have been cases, however, where the equipotential connections heated up to such an extent that they had to be removed. In such cases a closer examination has shown that the pitch error of the equipotential connections was too great.

The Action of Equipotential Connections in Series-Parallel Windings.

The successful working of equipotential connections on the commutation is accounted for in two ways: Firstly, they cause a more equal distribution of the current among the different brush sets, and secondly, they supply a non-inductive path, in parallel with the brush, for the additional short-circuit currents, and thus

FIG. 1.—OSCILLOGRAM OF CURRENT IN ARMATURE COIL.

relieve the brush of some of the load. It is true that with series-parallel windings all the brushes of the same sign are connected through the short-circuited coils, but the equipotential connections supply for the current a path of less resistance, as they are almost non-inductive, and moreover it must be observed that if the number of armature paths ($2a$) approaches the number of poles ($2p$) or becomes greater than ($2p$) only two consecutive brushes of the same sign are directly connected through a short-circuited coil.

A proof that a considerable part of the additional current will go through the equipotential connections is given by the oscillogram (Fig. 1), which shows the course of the current, with regard to time, of one armature coil of a six-pole machine with

series winding without equipotential connections and running without load. All the six brushes were on the commutator and considerably (by 30 electrical degrees) displaced from the neutral zone. Since the external circuit was open there was only the additional short-circuit current in the armature. *A, B, C, D* show the coil in short-circuit. It is notable that the curves *A, B, C, D,* which belong to different brushes, are very different. The experiment showed, however, that the curves from the same brush which were taken after one another and apparently under the same conditions, were in many ways different in shape, so that the curves *A, B, C, D* could have belonged to the same brush. In the parts between *A* and *B, B* and *C* the coil is not without current, but a part of the short-circuit current flows through it, i. e., *a part of the additional short-circuit current of a coil flows through the winding from one brush to the neighboring one.*

If we remember now that equipotential connections have a smaller inductive and ohmic resistance than an armature path, it is evident that *in consequence of the different shape of the short-circuit current curves (e. g., A and C or B and D), or if the brushes of the same sign do not short-circuit at the same time, internal currents must flow between the connected coils.*

The equipotential connections have, therefore, the following action:

1. In cases of unequal resistance between the brushes and the commutator an internal current flows through the non-inductive equipotential connections.

2. The additional short-circuit currents pass partly through the equipotential connections and therefore the brushes are relieved of some of the load.

3. The internal currents which arise in consequence of dissymmetry of the field operate in such a way as to damp out the dissymmetry and the difference of the pull of the field on the armature is diminished.

4. The potential difference between neighboring segments becomes more equally divided around the circumference of the commutator.

THE POTENTIAL PITCH.

The following symbols will be used in the further investigation:

K = number of commutator segments.
Z = number of slots.
u_n = number of coil sides in a slot.
a = half the number of armature paths.
p = half the number of poles.
y_k = commutator pitch.
y_p = potential pitch.

As the author has shown* in the *E. T. Z.*, 1902, page 215, the potential pitch of a series-parallel winding is

$$y_p = x \cdot y_k \pm x \frac{a}{p}, \qquad (1)$$

in which

$$y_k = \frac{K}{p} \mp \frac{a}{p} \quad \text{or} \quad K = p\,y_k \pm a. \qquad (2)$$

There are in general a points to be connected in a system of equipotential connections, and in order to connect the points it is necessary to make at least $(a - 1)$ potential pitches, and every a potential pitches form a closed figure; i. e.,

$$y_{p1} + y_{p2} + y_{p3} \ \ldots \ + y_{pa} = K.$$

If we write equations (1) and (2) in the following form:

$$y_p = x \left(y_k \pm \frac{a}{p} \right)$$

and

$$K = p \left(y_k \pm \frac{a}{p} \right)$$

it is seen that

$$x_1 + x_2 + x_3 + \ldots x_a = p.$$

It is not necessary that all the a values of x be equal, the a values of y_p will then also be unequal. If $x \cdot \frac{a}{p}$ is not a whole number, y_p will not be a whole number. It is, however, advisable to make y_p a whole number, even if $x \frac{a}{p}$ is not a whole number. In order that the difference between the calculated value of y_p and the nearest whole number shall be as small as possible, x must be as nearly as possible $= \frac{p}{a}$.

If we fulfill this condition $x \frac{a}{p}$ will be equal to or nearly $= 1$, and we *obtain immediately from formula* (1) *the integral value* of y_p from

$$y_p = x\,y_k \pm 1. \qquad (3)$$

For these pitches also is the condition fulfilled that

$$y_{p1} + y_{p2} + y_{p3} \ \ldots \ + y_{pa} = K = p\,y_k \pm a.$$

From the fact that with a series-parallel winding a points are connected to the same system, we get generally for every winding the main condition:

$$\frac{K}{a} = \text{a whole number.}$$

If we consider the current circuits which are formed by any two equalizing systems and the coils lying between the connecting points, then in every closed circuit an equal number of coils must be arranged in opposition. This only happens for all current circuits when $\frac{K}{a}$ is a whole number.

EQUIPOTENTIAL CONNECTIONS FOR REGULARLY DISTRIBUTED WINDINGS.

A regular distribution of the winding on the armature occurs with smooth armatures, or slotted armatures with one coil side or with two coil sides lying above one another in a slot.

We will now distinguish between the following series-parallel windings.

(1) $\frac{p}{a}$ *is equal to a whole number.*

For this winding $x = \frac{p}{a}$ is a whole number and therefore $x \frac{a}{p} = 1$. The pitches can be made without error. The potential pitch will then be according to equation (1):

$$y_p = x \cdot y_k \pm x \cdot \frac{a}{p} = \frac{p}{a}\, y_k \pm 1 = \frac{K}{a}.$$

(2) $\frac{p}{a}$ *is not equal to a whole number.*

For this winding $x \frac{p}{a}$ is not a whole number. The pitches cannot be made without error, and we must use formula (3) to calculate them.

The difference between the pitch y_p and the correct value, or the pitch error, is

$$a_x = \pm \left(1 - x \frac{a}{p} \right) \qquad (4)$$

a_x is measured in commutator segments and corresponds to an angle

$$= \frac{2\pi}{K} a_x \text{ radians,}$$

in electrical degrees, i. e., referred to a two-pole machine, since we have in the reduced scheme a pole pairs:

$$a_x^\circ = a \frac{360}{K} a_x. \qquad (5)$$

The formula hold good for a p. If a is $> p$ then for $(a - p)$ potential pitches $x = 0$ and $y_p = 0$, and we must put $a = p$ in the above formula in order to calculate a_x.

*See E. Arnold "Die Gleichstrommaschine," Vol. I, Page 63.

If p and a have q as the greatest common factor, then $\frac{p}{q}$ is a whole number; if we connect, in this case, only q points to an equalizing system, we get connections without error.

The potential pitch for these connections is

$$y_p = \frac{K}{q}.$$

To this group belong those windings in which $\frac{a}{p}$ is equal to a whole number. In these windings p is the greatest common factor of p and a, and p points can be connected to an equalizing system without error. For these connections the potential pitch, y_p, is equal to $\frac{K}{p}$.

Besides this $q\left(\leq \frac{a}{p}\right)$ neighboring conductors may be connected together at different places on the armature if the error,

$$\alpha_x^\circ = p\,\frac{360}{K}\,(q-1), \qquad (6)$$

is not greater than 3°.

PARTICULAR CONDITIONS FOR EQUIPOTENTIAL CONNECTIONS WITH SLOTTED ARMATURES.

When the coils are placed in slots there is an unequal distribution of the coil sides on the armature circumference, and only with one coil side or with two coil sides lying above one another in a slot can we obtain an equal distribution.

If we wish to secure a points of a system with equal potential, certain conditions must be fulfilled. If these conditions with certain proportions cannot be fulfilled, the deviation from the position of equality of potential must be calculated.

That the number of commutator segments must be divisible by half the number of armature paths is also the principal condition of symmetry for slotted armature, i. e.:

$$\frac{K}{a} = \text{a whole number.}$$

We will consider first the series-parallel windings when $\frac{p}{a}$ = a whole number. Potential pitch $y_p = \frac{K}{a}$.

In order that with these windings a points shall lie in fields of equal intensity,

(1) a slots must lie in fields of equal intensity;

(2) the a conductors which are connected to a system must have similar situations in the slot.

These two conditions are fulfilled if $\frac{Z}{a}$ is equal to a whole number. In this case we get a whole number of slots for every $\frac{p}{a}$ double-pole divisions and for every a^{th} part of the armature circumference the slots lie in similar positions relatively to the poles.

We will examine to what extent unsymmetry is produced if $\frac{Z}{a}$ *is not a whole number.*

In Fig. 2 a series-parallel winding is shown in which $a = p = 2$, and $s = 76$; $K = 38$; $Z = 19$.

$$\frac{K}{a} = \frac{38}{2} = 19 \text{ is a whole number.}$$

$\frac{Z}{a}$ is not a whole number.

The error arising from the fact that $\frac{Z}{a}$ is not a whole number is two-fold:

Firstly, the coil sides which are connected to the same system lie in slots which are in fields of different intensity, and have different positions in these slots (viz.: 3, 41); the conductors, 3 and 43, have similar positions in the slots).

Secondly, when we consider the current circuit made up of two equalizing connectors, and the conductors which lie between the points of connection we see that there are always conductors which, lying in different slots, are arranged in series.

If we consider the circuit

a—coil side 3—24—43—64—b—(equipotential circuit b—c)

c—coil side 26—5—62—41—a—(equipotential circuit d—a)

it is seen that the sides 62 and 64, and 41 and 43 lie in the same slots (viz., slot 16 and 11, respectively), while the sides 3 and 5, and 24 and 26 lie in neighboring slots (viz., slots 1 and 2, 6 and 7, respectively). In the coils 43—64 and 62—41 approximately the same e.m.f's will be produced, while in the coils 3—24 and 26—5 the induced e.m.f's are different.

This unsymmetry always appears if the conductors which are

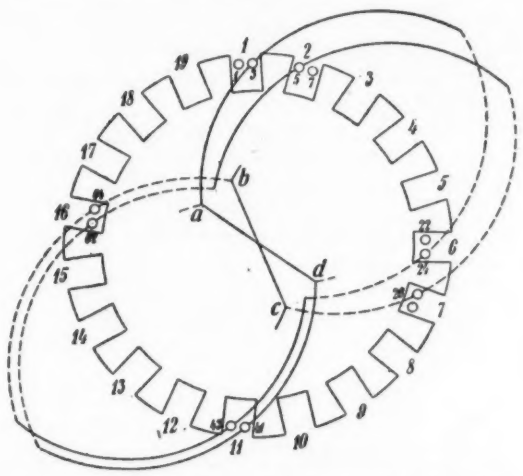


FIG. 2.—DIAGRAM OF SERIES-PARALLEL WINDING.

connected together in the same equalizing system have not the same situation in the slot.

With these windings great importance must be attached to insuring that $\frac{Z}{a}$ is a whole number.

Consider now the case in which $\frac{p}{a}$ is not a whole number.

In these windings the potential pitches, which are different, are determined from the formulæ:

$$y_p = x\,y_k \pm 1$$

and $$x_1 + x_2 + x_3 + \ldots x_a = p.$$

If we take as unity the distance between two conductors instead of the distance between two segments, this pitch becomes $2y_p = 2\,x\,y_k \pm 2$. Since the values of x must be as nearly as possible equal and integral, there will always be two values of x, which differ by 1 from one another. We can put, therefore,

$$2\,y_{p_1} = 2\,x_1\,y_k \pm 2.$$
$$2\,y_{p_2} = 2\,x_2\,y_k \pm 2 = 2\,(x_1\,y_k \pm 2) + 2\,y_k.$$

Now, in order for the conductors which are connected in the same system to have the same situation in the slot, the pitches, $2\,y_{p_1}$, $2\,y_{p_2}$ . . . must be divisible by u_n. This is only possible for all pitches when $u_n = 2$. If we assume that $2\,y_{p_1}$ is divisible by u_n, then in order that $2\,y_{p_2}$ may be likewise divisible by u_n, $2\,y_k$ must be divisible by u_n. If, however, $2\,y_k$ is divisible by u_n, then $2\,y_{p_1} = 2\,x_1\,.\,y_k \pm 2$ cannot be divisible by u_n $(u_n > 2)$.

It appears from this that the conductors connected to the same system have different positions in the slots. Moreover, the slots in which are placed the conductors which are connected to the same system are in fields of different intensity, since $\frac{Z}{p}$ can never be equal to a whole number. With these windings there is always the unsymmetry explained above; and unsymmetry

occurs also for $\frac{Z}{a}$ = a whole number, and the error thus caused can become just as great as when $\frac{Z}{a}$ is not a whole number. According to the experience of the author, it is nevertheless desirable where possible to make $\frac{Z}{a}$ equal to a whole number. Machines with $\frac{Z}{a}$ not equal to a whole number have indeed been often made, and have worked well so long as the errors do not go beyond a certain limit.

If p and a have a greatest common factor, g, then $\frac{p}{g}$ is a whole number. Further, if $\frac{Z}{g}$ is a whole number and g points are connected in an equalizing system, the connections are obtained without error.

To this group also belong the windings with $\frac{a}{p}$ equal to a whole number. If $\frac{Z}{p}$ is equal to a whole number, p points can be connected to the same system without error. Moreover, $\frac{a}{p}$ coil sides which lie together in a slot may be connected together at a few places on the armature, although their potentials are not exactly the same. The error thus arising may be calculated from formula (6).

100,000-Volt Experimental Transmission Line.

By K. WERNICKE.

IN testing high-tension insulators for transmission lines, storm conditions such as rain, fog, snow, etc., are taken into account by pouring water over the insulator and determining the voltage at which the brush discharges, around the insulator to the pin, occur.

It would be far better and more in accordance with present-day practice to test insulators under actual operating conditions; that is, by mounting them on a pole in the open air and determining the voltage at which brush discharge occurs under various conditions of weather. Artificially produced rain can be taken as a substitute for rain which falls nearly vertically. However, as a matter of fact, rain is often accompanied by high wind and in many cases is driven horizontally against the insulators; in these cases artificial rain would be of little use in determining the behavior of the insulator under storm conditions.

Mr. Robert M. Frieze explains the cause of brush discharge over wet insulators, thus: The upper surface of the top petticoat of the insulator is rendered conducting by the film of rain water, and the little streams of water which fall from the edge of the top petticoat have the same potential as the line; therefore these streams do not follow the laws of gravitation, but are attracted toward the pin, which is of opposite potential; thus it is that the water forms a conducting path between the line conductor and the pin. A wind which drives the rain in a nearly horizontal direction will naturally assist the action described by Mr. Frieze, and thus lower the potential at which the discharge occurs to a value which truly corresponds to actual practice. Having once determined correct values for the potential of discharge it is possible to decide on a safe working voltage for the insulator.

Of course, it is not necessary, and in manufacturing on a large scale it is utterly impossible to test all insulators in this manner, since an incalculable amount of time would be lost in waiting for the desired weather conditions. A few samples of each type should be chosen and thoroughly studied and tested so as to make it possible to judge the quality of other insulators of the same type. Every insulator which leaves the factory should be subjected to the puncture test so as to detect faults in the material.

In order to test high-tension insulators under actual working conditions, the Insulatorwerke A. G. in Pankow, near Berlin, erected an experimental line equipped with insulators made by the Ambroin Werke (Kleinsteuber patent). It is thought

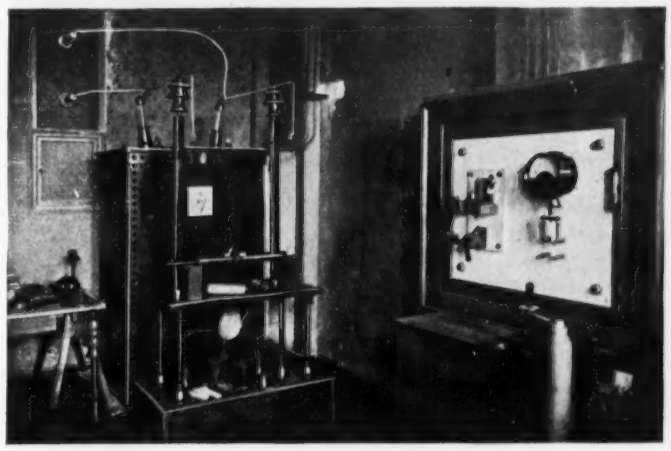


FIG. 1.—TRANSFORMER ROOM.

that a description of this line should be of interest, since a pressure of 100,000 volts is used, and furthermore in addition to the transmission line in the open a part of the line is carried indoors and under conditions which could scarcely be called favorable. At two points in particular, special care was required, namely, where the conductors passed through a masonry wall and a doorway, respectively.

The line commences in the transformer room (Fig. 1). In this room is located a 20-kw transformer built by the British Westinghouse Company and having a transformation ratio of 2:1000. In the foreground and at the right is the switchboard for the transformer. It is equipped with a two-pole switch, an overload circuit breaker, a hot-wire voltmeter and a hot-wire ammeter, all in the primary circuit. Although the volt-

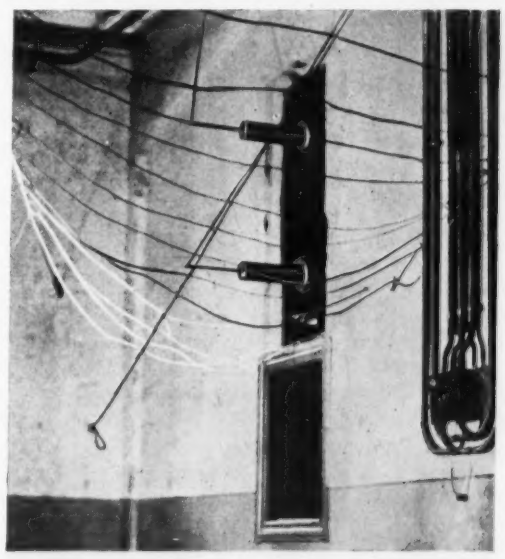


FIG. 2.—WIRES ENTERING TRANSFORMER ROOM.

meter is connected in the primary circuit, the scale is calculated, from the ratio of transformation, to read the secondary voltage. The ammeter is fastened at the side of the switchboard (not visible in the illustration). The primary current measured 18 amperes with the secondary on open circuit at 100,000 volts.

In front of the switchboard is seen the regulator; this regulator is similar in construction to a railway motor controller and permits the variation of the pressure in steps of 10,000 volts. The sudden jumps from one voltage to the next higher, which

were necessary evils with this style of regulator, often caused surges which would operate the breaker in the primary circuit. On account of these annoyances the above type of regulator was replaced by an induction regulator which permits a gradual change from the lowest to the highest voltage.

The line conductors, which consist of bare zinc plated copper wire 1.5 mm. in diameter, are carried through the wall above and at the left of the transformer (Fig. 1). The entry, which is shown in the illustration, consists of an Ambroin plate 1,000x1,000x25 mm. through which are passed two Ambroin tubes, 60 mm. outside diameter, 26 mm. inside diameter, 600 mm. long and 500 mm. between centers. Round metal rods are fastened in these tubes by means of Ambroin sleeves, the ends of the rods being provided with clamps for connection to the line conductors. Fig. 2 shows the entry from the other side. This illustration also shows the hemp string net which is strung underneath the line throughout its length in order to catch broken conductors and prevent them from reaching the ground. (The net was purposely made of non-metallic material to prevent condenser effect.)

The conductors next pass through a narrow floor, and in order to do this they make a right angular turn. The wires are here carried upon Ambroin insulators supported upon wall brackets. Passing through the entry in the door the line reaches the open air. This entry is constructed in exactly the same manner as the one in the transformer room, except that the conductors are placed side by side instead of one above the other. Fig. 3 shows the entry from the outside. It may here

FIG. 3.—WIRES ENTERING BUILDING.

be noted that the gas lamp which is very near the line, burned while the experiments were being carried on and caused no trouble. (It is also worthy of note that the low-potential conductors laid in conduit, which can be seen in Fig. 2, near the entry, did not cause any disturbances worth mentioning.) The last stretch of the line passes over the factory court yard and ends on a wooden pole five meters high, upon which are mounted the insulators to be tested (Fig. 4). The insulators shown in the illustration do not belong to the so-called standard types, but were special forms which were used only in the first few tests.

From Fig. 4 it is seen that the connections are so made that the insulator at the left is subjected to the full working line voltage, while the one at the right, in this case, serves only to insulate the incoming line. The four supports under the insulators, which are also made of Ambroin, serve to increase the insulation to the pole or ground or to insulate the insulator from the pole.

There is also an arrangement whereby a considerable number of insulators can be set upon level ground and tested. For this purpose wires are led from the main line to the various points in the factory court yard where insulators are mounted to be tested under all sorts of weather conditions.

The first tests were limited to simple trials made to determine the safety and reliability of the installation. These consisted of impressing full voltage (100,000 volts) upon the line for one hour each day for three successive days. On the first day there was a heavy rain and on the two following days there were big snowstorms, nevertheless there were no noticeable disturbances, not even at the entries, which are the weakest points in the installation.

The only trouble experienced was caused by the opening of the circuit-breaker, when the voltage was raised too rapidly.

FIG. 4.—ARRANGEMENT OF INSULATORS DURING TEST.

Since, as was mentioned above, the voltage was varied in steps of 10,000 volts, an extra rise in current accompanied each advance of the voltage. Now when the operator did not pause about 15 seconds on each step the surges were so great as to cause the circuit breaker in the primary circuit to operate. When care was taken to pause at each step the disturbances were greatly reduced, but since the installation of the induction regulator there has been absolutely no sign of trouble from this source. The extra rise in potential could be detected along the line by a sharp clicking sound, so that the observer stationed in the factory court yard could follow the adjustment of the regulator from step to step without being in communication with the attendant in the transformer room. At 40,000 volts there is a perceptible corona about the wires and a humming sound which denotes the passage of electricity into the atmosphere. At 100,000 volts there is a corona at the points where the conductors pass through tubes in the entry plates;

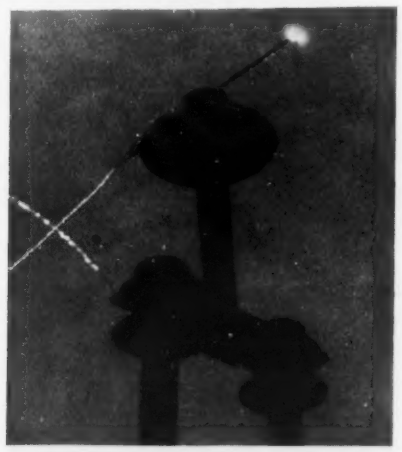


FIG. 5.—FORMATION OF CORONA AT HIGH VOLTAGE.

the transformer terminals and, in fact, everything connected to the line is surrounded by a glow of light. After the reliability of the installation had been proven, by the preliminary tests, the actual tests upon insulators were begun. The testing plant has now been in almost daily use for six months and works as well now as the first day it was put in service.

Fig. 5 shows one of the insulators mounted upon the wooden pole while being tested with 100,000 volts. The corona on the conductors is sharply outlined against the dark night sky and

many points of light can be seen radiating from the edges of the insulator as well as at the point where the insulator is joined to the support. The bundle of rays at the end of the line is especially beautiful. The successful operation of this testing plant has proved that an installation operating at 100,000 volts, when properly insulated, is perfectly feasible even for conductors carried indoors.

Comparison of Thury and Three-Phase Systems.

At a time when the direct-current transmission system of M. Thury is being widely considered in connection with long-distance power transmission and especially in the case of the 700-mile transmission from the Zambesi Falls of South Africa, it is interesting to note the results arrived at under certain conditions by Signor Engineer Motta of the Milan University, who, acting on behalf of the City Council, undertook a lengthy series of calculations and tests, and has finally decided in favor of the three-phase system and against the direct-current system.

The city of Milan has its public lighting provided by its own steam plant, and the private lighting and power for traction is supplied by the Milan Edison Company, which our readers will recall, is one of the oldest electric power companies of the world. The tramway system, however, is the property of the municipality, and of late strong agitation has arisen in favor of making the tramway system entirely municipal. The general conditions are as follows:

Water rights have been acquired at Grosoto on the Upper Adda River, in Valtellina, which will have sufficient supply to provide 38,200 brake hp at the turbine, or approximately 28,000 kw at Milan at the secondaries of the transformers. The transmission line is to be 150 km. long and will pass over the Orobie Mountains, a part of the Pre-Alpine range, the highest point being 3,500 ft. above sea level.

The comparison above referred to was made on the basis of 150,000 volts continuous current and 60,000 alternating three-phase current, these values being settled by consideration of the most economical voltage of each system.

The Thury system was to consist of ten groups, each group to have four generators, driven by one water turbine, the voltage limit per group being 15,000 volts. The preliminary system provided for a direct-current transmission line, having both positive and negative conductors, the earth return not being employed and no permanent ground to be made at all on the system.

The 60,000-volt, three-phase scheme will consist of a number of units operating in multiple in the usual way with no novel features, the exact frequency to be determined later, but probably it will be 42 cycles.

The summary may be divided into two comparisons, as follows:

EFFICIENCY COMPARISON.

Continuous-Current System.

The over-all efficiency of the two systems shows 3 per cent in favor of the three-phase plan, the values given below being based on the full load of 28,000 kw. The detail efficiencies are as follows:

Water pipe's efficiency	96.5%
Turbine's efficiency	75
Generators	92
Line	95.3
Motors	92
Alternators for secondary distribution	93
Giving a total over-all efficiency of	54.2

Three-Phase System.

The efficiency water pipes and turbines remain the same; that of the line, however, drops to 91 per cent, and the total over-all efficiency is 55.8 per cent.

Cost Comparison.

The costs of the two schemes as calculated show in favor of the direct-current system by 1.6 per cent, the figures being approximately 10,000,000 francs for the direct-current transmission and 10,160,000 francs for the three-phase system. These costs are based on machinery, switchboards, line, insulators, poles, transformers for the alternating system, and motor-generator transformers for the receiving end of the Thury system.

The following subdivided costs are of interest as showing a remarkable feature of the direct-current Thury system, viz.: the extreme cheapness of the transmission line and the high cost of the motor-generator transformers at the receiving end.

Continuous-Current System.

1. Machinery, including transformers, switchboards, etc., 7,000,000 francs.

2. Line, including insulators, poles, lightning arresters, etc., 3,000,000 francs.

Alternating-Current, Three-Phase System.

1. Machinery, including transformers, switchboards, etc., 3,750,000 francs.

2. Line, including insulators, poles, lightning arresters, etc., 6,410,000 francs.

The actual calculated cost of the machinery for the Milan Thury system sub-station was 3,600,000 francs, whereas the cost of the transformers for the three-phase system did not exceed 790,000 francs.

The costs include the interest on capital during construction. The period of construction may be assumed the same in each case, the cost per kilowatt per year, including all items, gives a calculated value of 160 francs for the three-phase system, this being based on the assumption that 8,640 hours per annum will be demanded—that is full load the whole year—which, under the peculiar conditions of power demand in the city of Milan, is not an unreasonable assumption.

An additional steam station for peak loads with a maximum output of 9,000 kw and an average of 4,500 kw for the whole year, and provided with accumulators will also be provided, but no estimates of cost have as yet been prepared for this scheme.

The demand for power in the city of Milan during the last few months has increased so rapidly that it is doubtful if this scheme will be sufficient, and power is being eagerly sought for from other sources.

The traction system in Milan may be said to operate for 17 hours in every 24, and during the remaining seven hours some of the factories will be offered exceptionally cheap rates to encourage their operation at this time, for this class of customers at present 3,000 kw are supplied every night.

Other details of the comparison of interest are as follows:

The three-phase line to consist of three wires, each of 240 mm² section, and the direct-current line to consist of four wires, two for each side and each of 140 mm² section. One feature which was a strong consideration in the decision to adopt the three-phase system instead of the direct-current system was the proposal of M. Thury to have 104 commutators in series throughout the whole system.

High Tension Cables at the Milan Exhibition

BY C. T. WILKINSON.

The Milan Exhibition offers to electrical engineers an opportunity to study transmission problems under particularly favorable conditions. The great strides taken by Northern Italy in recent years, which have placed her in the forefront of progress, have been most prominently exhibited in the useful application of her numerous waterfalls for the development of electric energy to be used in factories and for power and lighting. This has covered the country with a great network of transmission lines and developed many manufactories for the production of transmission line apparatus.

Among the cables shown the most interesting and important exhibited is that of the Pirelli Company, of Milan, whose high-tension cables are known all over the world, and the recent purchase of which by the Ontario Power Development Company of Niagara has created much comment. American readers will perhaps recall the interesting and important paper read at the St. Louis Convention by Mr. Jona, chief engineer of this firm, and now president of the Italian Institute of Electrical Engineers.

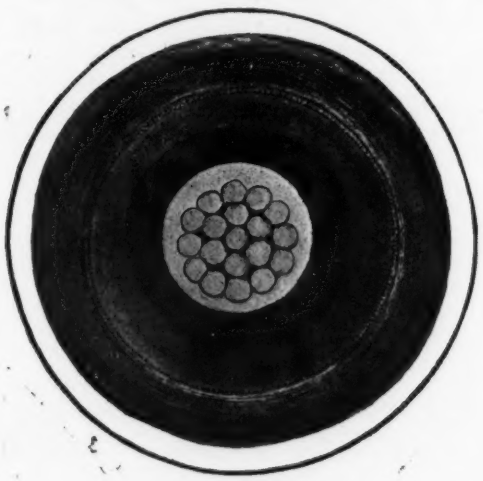
In this paper and in other public works Engineer Jona has developed the theory of grading of cables for capacity, an idea which originated with Mr. O'Gormann, of England, and has now been carried so far that an accurate idea of the stress occurring

in a high-tension transmission cable may be easily deduced. At the St. Louis Exhibition this firm showed a cable designed for a normal working voltage of 50,000, while now at the Milan Exhibition they exhibit a cable designed for 100,000 volts, normal working pressure, which is confidently expected to stand with ease 200,000 volts, and which will be tested with a special 300,000-volt transformer, now in course of construction, at the time of the Milan Exhibition Engineering Congress to be held in September. This cable has been already tested to 150,000 volts without having apparently sustained the slightest damage.

In this cable advantage is taken of all theoretically important points, the stranded conductor being covered with a lead sheath, thus producing a smooth surface of much greater radius, and by this simple device alone the static strain is considered to be reduced more than 10 per cent. The insulation is then wrapped in layers disposed in the order of decreased specific inductive capacity from the center of the cable to the circumference, and by careful choice of the materials an extremely uniform potential gradient to alternating current is presented.

The following details of construction given by the manufacturers will be of much interest when it is considered that this is the first cable ever built to withstand such a high voltage.

The conductor consists of 19 wire strands, each wire 3.3 mm. in diameter, the total section of copper being 162 mm.^{2} These strands are covered with a lead tube having 18 mm. outer diameter. It is insulated with a first layer of rubber 2.5 mm. thick, and having a specific inductive capacity of 6.1; then with a second and third layer of rubber of 2.3 mm. and 4.5 mm. thickness and a specific inductive capacity of 4.7 and 4.2, respectively. Over this rubber is a layer of impregnated paper 5.2 mm. thick,



SECTIONAL VIEW OF CABLE.

having specific inductive capacity of 4, the cable being then hemp-coated and lead-covered. The total thickness of insulation is 14.5 mm.

The manufacturers state that no radical changes are made from the cable shown at St. Louis, the great difference being in extreme care in manufacture and selection of the materials of the different wrappings. It is interesting to note that the over-all diameter from outside of lead to outside of lead is only 2 5/16 in.

Other exhibits of Messrs. Pirelli consist of numerous designs of cables for all capacities and voltages. A large collection of rubber appliances for mechanical purposes and for rubber tires for automobiles and cycles, forms a special stand, this being a new department of the company, which has been very successful recently.

The recent development of this firm since the period of the St. Louis Convention has been very striking in all departments, and engineers visiting the exhibition should take an opportunity to see these important works. More than 30,000 sq. meters are covered with buildings and more than 3,200 men are employed at the Milan factory alone.

Of special interest, as illustrating the energy of this firm, is the employment of a special staff for the study of every important and delicate research connected with rubber tires for motor vehicles, and perhaps American manufacturers could learn something from the skill with which the various products of the rubber or gutta-percha class are saved, and each grade or quality is used up in some apparently secondary purpose.

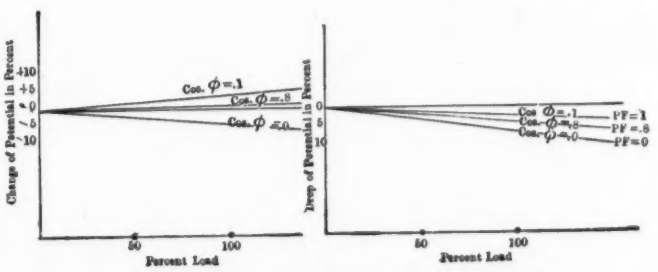
"Image Current" Alternators.

By G. Faccioli.

In a paper read by Mr. William Stanley at the annual convention of the American Institute of Electrical Engineers at Asheville, N. C., a description of alternators excited by low-frequency alternating currents was given and the characteristics of such machines were explained when the generated frequency is either the sum or the difference of the excitation and rotation frequencies. Owing to the fact that the conductors of the field winding are driven at a speed different from the speed of electromagnetic rotation of the air-gap flux of the machine, any load current flowing through the armature of the alternator is exactly reproduced in its field circuit. These reproduced currents in the field circuit are termed "image currents" because they are, in reality, the reflection from the load currents delivered by the armature circuit. Such currents are characteristic of asynchronous machinery, and were discussed in the paper above referred to.

The machine described below differs from those heretofore discussed in two important particulars. First, because the characteristic of the machine is substantially independent of the size of its conductors. Second, because the exciter is not compelled to carry the energy image currents of the alternator and is, therefore, of normal size. In this last development of this type of machine the alternator is excited by low-frequency currents whose armature reaction is compensated by image currents flowing internally in the machine.

In all machines of this type heretofore constructed, the size of



FIGS. 1 AND 2.—REGULATION CHARACTERISTICS.

the exciter has been substantially proportional to the capacity of the alternator times the ratio of the excitation and the generated frequency, because the exciter carried image currents proportional to the currents generated. In order, therefore, that such a machine should be commercial, it was necessary to reduce the excitation frequency to the lowest possible value, and in the article above referred to, the relations between the exciting frequency and the characteristics of the alternator together with the limits to which such frequency might be reduced, were established in detail. Careful tests have determined that an exciting frequency of from two to five cycles per second can be conveniently employed. It will be well to review briefly the performance of these machines under different conditions of excitation.

When the generated frequency of the alternator is equal to the difference of the frequency of rotation and the frequency of excitation, the magnetization of the machine is higher when loaded with non-inductive load than when running free, this result being principally due to the ohmic resistance of the field circuit of the alternator which prevents the image current from entirely neutralizing the magnetomotive force of the armature current. The resultant of the magnetomotive force of the load and image currents assists the no-load magnetization of the machine at non-inductive load, but tends to depress the original magnetization at inductive load. The result is that the terminal voltage of the alternator increases with non-inductive load and decreases with highly inductive load. The regulation curves obtained in this case are represented in Fig. 1.

When, however, the generated frequency is equal to the sum of the excitation and rotation frequency, the resistance of the field

circuit has a positive reaction; that is to say, it tends to decrease the magnetization and therewith the terminal voltage of the machine at both inductive or non-inductive loads. The regulation curves obtained in this case are represented in Fig. 2.

It is evident that if these two effects are combined and opposed

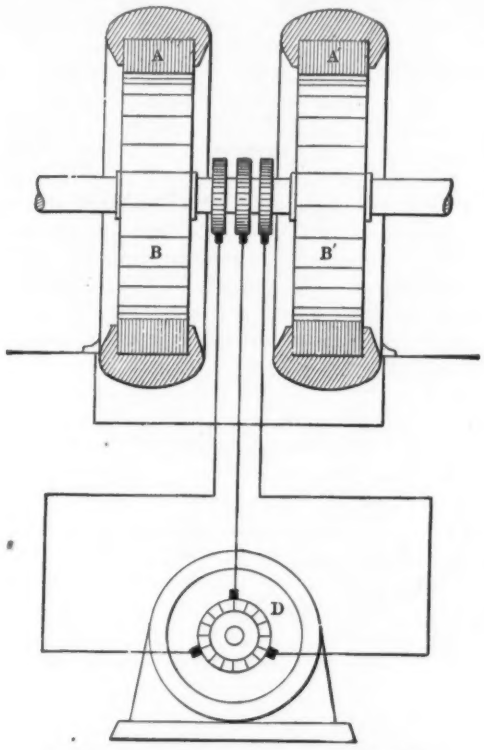


FIG. 3.—IMAGE CURRENT ALTERNATOR.

to one another, the apparatus can be made to keep constant terminal potential at non-inductive load. This result is reached by Mr. Stanley with the apparatus shown in Fig. 3. The diagram of connections is given in Fig. 4.

Referring to Fig. 3, the apparatus is made up of two alter-

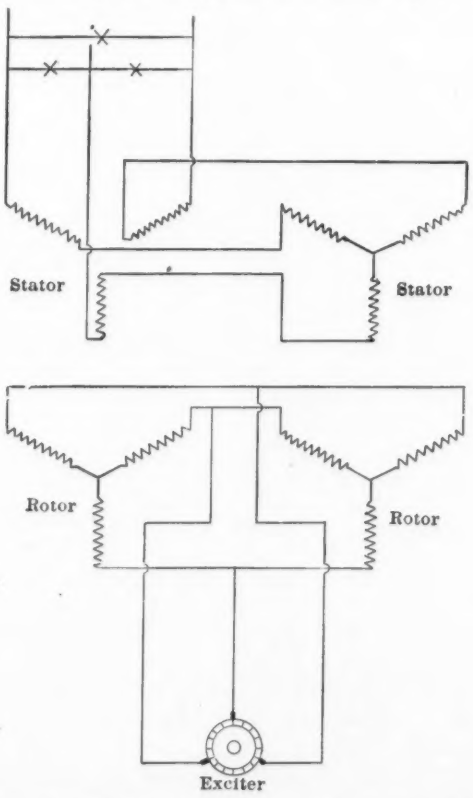


FIG. 4.—DIAGRAM OF GENERATORS WITH THREE-PHASE EXCITATION.

nators, each alternator consisting of a stationary member, the armature, and a rotating member, the field. The stators, *A* and *A'*, of the two machines are both of the standard type and provided with polyphase armature windings. The rotors, *B* and *B'* are similar in construction to the rotors of induction motors and are also provided with polyphase windings. *D* is the exciter supplying the low-frequency exciting currents. The rotors, *B* and *B'*, are mounted on the same shaft and their windings (Fig. 4) receive current in parallel from the exciter, *D*. The connections, however, are such that while the magnetic field of one of the alternators is rotating in the same direction as the mechanical rotation of the rotors, the field of the other alternator is rotating electromagnetically in the opposite direction. As a result of this

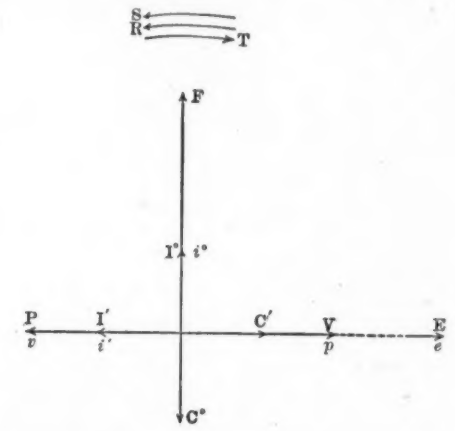


FIG. 5.—PHASE RELATION OF FLUXES AND E.M.F'S IN EXCITER.

arrangement the frequency generated in the armature, *A*, is equal to the sum of the rotation and excitation frequencies, while the frequency generated in the armature, *A'*, is equal to their difference. The two armatures are in series; it is, therefore, necessary that the generated frequencies of the two machines be identical. This result is obtained by winding the two alternators with different numbers of poles.

If, for instance, the exciting frequency is 5 cycles and the mechanical speed of the rotors is 600 r.p.m., then the alternator energized by the forward rotating field can be wound with 10 poles, while the alternator energized by the backward rotating field will be wound with 12 poles. In this case, the frequency, of rotation of the first machine is 50 cycles, and the generated frequency is 55 cycles. The frequency of revolution of the other machine is 60 cycles, and the generated frequency is again 55 cycles.

It is to be noted that if the speed of the alternators is changed but the frequency of excitation is kept constant, the generated frequencies of the two machines will no longer be alike. On the other hand, if the frequency of excitation will vary proportionally to the speed of the alternators, the generated frequencies will continue to be identical.

If, for instance, in the case above referred to, the speed of the machine drops from 600 to 300 r.p.m., and at the same time the exciting frequency decreases from 5 to 2½ cycles, the machine energized by the forward rotating field will have a generated frequency equal to $25 + 2\frac{1}{2} = 27\frac{1}{2}$ cycles, and the machine energized by the backward rotating field will have a generated frequency equal to $30 - 2\frac{1}{2} = 27\frac{1}{2}$ cycles.

Since, in the type of the exciter used in this apparatus, the frequency of the current delivered by the exciter is proportional to its speed, it is evident that it is necessary to have the speed of the exciter always proportional to the speed of the alternators.

It is obvious that each of the two machines carries one half of the load of the system. Fig. 5 gives the phase relation of the vectors representing the phenomena, neglecting leakage and resistance effects. *F* is the total flux of the machines, and it is supposed to be the same in both. *F* rotates at a speed corresponding to 55 cycles in the air gaps of both alternators and induces the electromotive force, *E*, at the terminals of the armature of the over-synchronous machine, and the electromotive force, "*e*," at the terminals of the other armatures. The electromotive forces, *E* and "*e*," are in phase, and they lag 90 deg. behind *F*. The arrow, *S*, represents the direction of rotation of the diagram regarding the armatures of the system.

Furthermore, the flux, *F*, rotates at a speed of 5 cycles with respect to the conductors of both rotors, and it cuts them in

opposite direction. The diagram will, therefore, rotate as far as the rotors are concerned, in the direction, *R*, for the over-synchronous machine, and in the direction, *P*, in the other machine. The flux, *F*, will then induce at the terminals of the rotor of the over-synchronous machine an electromotive force, *V*, and at the terminals of the other rotor, an electromotive force, "*v*," opposite in phase to *V*. The potential of the exciter is then *P* for the over-synchronous machine and "*p*" in the other.

Let us now suppose that the stator is carrying the load current, *C'*, in phase with the terminal electromotive force of the system. The image currents in the two machines are represented by *I'* and "*i*'" which are in phase and opposite to *C'*. If, however, the system is loaded with a wattless current, *C°*, the image currents are *I°* and "*i*°."

The result is that in the alternator driven above synchronism, the energy image current, *I'*, is in phase with the terminal voltage of the exciter; that is to say, when the alternator is carrying non-inductive load, the exciter is supplying energy to it. In the alternator driven against synchronism the energy image current, "*i*'," is opposite in phase to the terminal voltage of the exciter and therefore, the alternator when delivering currents at unity power factor from its armature, is also furnishing energy from its rotor to the exciter. On the other hand, when the system is loaded with wattless current, both image currents, *I°* and "*i*°," lag 90 deg. behind the terminal voltage of the exciter, and they have the same phase as the exciting currents

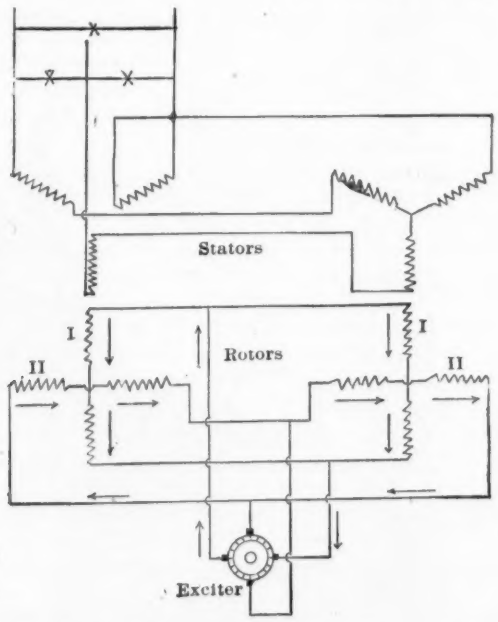


FIG. 6.—DIAGRAM OF GENERATORS WITH TWO-PHASE EXCITATION.

which are in line with the flux, *F*. In Fig. 6 the stators of the two alternators are represented three-phase, and the rotors for simplicity, are represented two-phase with independent windings in the two phases. The dotted arrows of phase I indicated the direction of the magnetizing and wattless image currents at a certain instant. The solid arrows in phase II indicate the relative direction of the image currents in the case of non-inductive load. It is evident that these last currents will circulate internally in the two rotors without flowing through the exciter; that is to say, by this arrangement the exciter is entirely relieved of the superimposed or image rotor currents. Therefore, the size of the exciter can be kept very small.

In case of inductive load, however, the wattless components of the image currents of the two machines will flow through the exciter. In conclusion, when the system is carrying non-inductive load, the exciter will furnish to the field coils of the alternator only the original no-load magnetizing currents and, therefore, the exciting voltage will be constant.

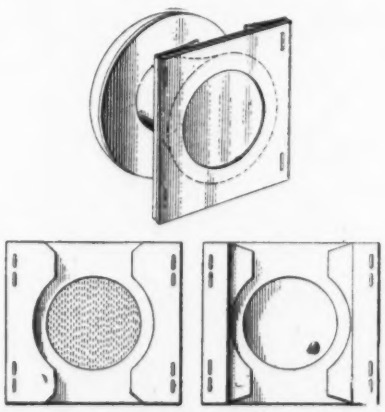
Under these conditions, the machine driven above synchronism will tend to drop its armature potential with an increase of non-inductive load and the other machine will tend to raise its potential. If the two machines are so designed that the two potential gradients are complementary, the terminal voltage of the system will be constant, or it is possible to have any desired amount of boosting of the terminal potential at non-inductive load by proportioning the resistance of the two rotors.

The regulation is substantially a differential effect and the individual potential gradients of the two machines may be allowed to reach considerable values, either by economizing in the design of the two alternators or by reducing the frequency of excitation with the purpose of further decreasing the size of the exciter. In the case of highly inductive load the potential of both machines will drop. Since, however, the regulation in this case is largely a function of the mutual induction between the stator and rotor, the drop can be limited by careful design. Furthermore, the type of exciter which is used in the system boosts its potential when delivering lagging currents. A compensation between the regulation of the alternators and the exciter is, therefore, automatic, but the phenomena involved in the operation of the low frequency exciter are so complex, and present so many interesting features, that they will be reserved for discussion at length in another article.

New Telephone Patents.

TRANSMITTERS AND TRANSMITTER ATTACHMENTS.

Inventors have apparently suddenly discovered a need for some more efficient means for shielding a transmitter from extraneous sounds that has heretofore been customary. In most instances a sealing of the mouthpiece by the hand of the user has been sufficient, while here and there cut-outs either improvised or supplied with the subscriber's set have been used. Recently Mr. R. A. Walton, of Los Angeles, patented a transmitter mouthpiece carrying a cam and transverse camshaft with projecting thumb button. To damp out the transmitter, the shaft is rotated by the manipulation of the button by the user, until its high part strongly rubs upon and damps the diaphragm mechanically. The same inventor has also tried an acoustic means of damping. This also is embodied in a mouthpiece extension piece. In this device the extension is in two parts arranged so that one may be rotated upon the other about their common axis. Each section has a transverse perforated diaphragm at the point of contact, the perforations registering only when the two parts have the proper angular relation. By twisting the mouthpiece, the diaphragms may be made at will to seal or expose the diaphragm chamber. Mr. G. A. Long, of Hartford, Conn., has patented means which are similar except that there is arranged a transverse slide held by a spring so that the single large aperture registers with the bore of the mouthpiece. The slide may be displaced transversely to seal the diaphragm chamber. Mr. R. A. Walton has also tried electrical means to accomplish the desired result, by mounting in the transmitter casing a diminutive short-circuiting switch, the handle of which extends through the casing. This switch in its abnormal position short-circuits the microphone button.



GRIMM MOUTHPIECE GUARD.

Antiseptic devices again seem to be receiving some attention,

as evidenced by a patent granted to Mr. G. E. Grimm, of Philadelphia, and shown in the cut, and also by a patent to Mr. G. W. Merritt, of San Francisco. Mr. Grimm's device is of pasteboard with an antiseptic gauze diaphragm. Mr. Merritt's device is a metallic lozenge shaped box with perforated ends and a projecting flange upon one-half its periphery which serves as a hook for holding the device across the face of the transmitter mouthpiece.

A transmitter for great power has been patented by Mr. H. G. Pape, of New York City. The diaphragm acts upon a spider with several arms, each one of which terminates upon the movable electrode of a microphone button. By this means a single diaphragm may give the full motion of its center to several different buttons used in conjunction.

LETTER TO THE EDITORS.

Pike's Peak Hydro-Electric Plant.

To the Editors of Electrical World:

SIRS:—In your issue of May 26 I note an article on the subject of the Pike's Peak Hydro-Electric Company and a description of the plant. While the article generally is a recital of facts, a wrong impression might be received from certain statements on the subject of a water wheel test, on page 1074, in which low efficiencies were reported, and also from the comments on the same subject on page 1062, wherein the cause of such low efficiencies was attributed to "increased frictional losses arising from the extreme jet velocity at impact" . . . "the loss is serious, for the discrepancy amounts to nearly 25 per cent." The readers of your journal have no way of proving or disproving the statements made, and no doubt they would pass into their minds as facts until sometimes the description of another plant might attract their attention, when they might possibly note that the pressure is still higher, say, 2,500 ft., and that the actual efficiency obtainable is 80 per cent or perhaps 81 per cent. I am offering this explanation believing that I am the only one in possession of the facts who will offer a reply.

In the beginning, I wish to state that the reported test was no test at all, because it was vitiated by inaccurate measurements. I conducted the original installation of the hydraulic equipment in that station. Upon completion of my work I learned that the plant could not be started and tested out for many months to come owing to the incomplete condition of the upper end of the pipe line and also owing to the lack of tailrace connection to the Colorado Springs water mains. I left the needle shafts and nozzles and also the governors disconnected, which would enable a thorough blowing out and cleaning of the pipe as soon as water could be turned in. I was then occupied in California nearly a year, and when the Hydro-Electric Company was ready to start, the manufacturers of the water wheel sent a representative, Mr. Kraze, who adjusted the equipments which were left disconnected, and started the plant, all of which, I understood, was done in a thorough and satisfactory manner. The Hydro-Electric Company was not at that time prepared to test the efficiencies of the equipments and it was not until the latter part of June, 1905, that a test was attempted.

The test might have resulted as stated in the article in question, but it had bearing on other things rather than to the real truth as to the efficiencies of the equipments. The manufacturer's representative, Mr. Peek, protested against making the test before putting the equipments in adjustment, which was objected to. He was the only representative of the manufacturers present to look after the water pressure and electrical output measurements and the water tank measurements of the water used—in fact, to look to everything. This would have employed four competent men, each at his post during the whole time of the test.

They used 2¾-in. nozzle tips during the test, which were more than ample for 50 per cent overload capacity. The water pressure was measured by a Crosby recording pressure gauge, "No. 69," having a range of record to 3,000 lb. per sq. in., and the trail left by the needle was 50 lb. wide, making it impossible to determine while working at 1,000 lb., nearer than 50 lb. to the real pressure. This, together with an error of many per cent, found in the switchboard watt-hour meters, which ran slow, could have been sufficient to account for the difference between the efficiency they claim to have obtained and the 80 per cent which they should have obtained.

I again went to the plant late in October, 1905, to re-equip the water wheels with new nozzle tips, to put the machines in adjustment and to make the efficiency tests. Prior to my arrival there had been a serious accident to the switchboard equipments by the burning of some oil switches, and the station was shut down for rebuilding the switchboard; therefore, I had ample facilities for examining the condition of the wheels. I found that the buckets were but little worn, but that the nozzle tips and needles were worn seriously by sand and also that they had been bruised badly in places, as though nuts, rivets, tools and other hard substances had been squeezed between the needles and tips by forcing the needle shaft upon the foreign substances by the severe screw pressure which it was provided with. These things, together with the too large and improper nozzle tips in use, would have reduced the efficiency. But the real thing that killed the efficiency was that the adjustments of the quadrants between the governors and the rock shaft which directs the nozzle for regulation, had been moved in such a manner as to cause part of the nozzle stream to miss the buckets entirely. Therefore, the test could have resulted in 15 per cent or 40 per cent efficiency with just as little surprise to anybody knowing the facts as the 69 per cent claimed.

The buckets of the machines are as excellent in design, material and workmanship as any I have ever seen. The entire equipment was first class. I completed the re-equipment of the machines about November 20 with new nozzle tips 2⅜ in. in diameter and with new needles and adjusted the center line of the nozzle stream to a central position in the buckets. These equipments then produced 1,000 hp each, giving full load capacity for their generators. Preparations were then made for an efficiency test. I had arranged for Prof. L. G. Carpenter, of the Colorado State Agricultural College, and Mr. Richardson, of the Denver Gas & Electric Company, to accompany me in the test.

We connected into the receiver a gauge tester procured from the University of California and also a set of electrical test instruments from the Pike's Peak Hydro-Electric Company with which we had calibrated the switchboard instruments. Finally, on the third day, we discovered that a workman at the plant had left the receiver house door open during the night and a large valve in the receiver had frozen and burst, leaving only an ice plug for resisting 950 or more lb. pressure. During postponement of the test, awaiting for settled conditions, the manager of the Pike's Peak Hydro-Electric Company acknowledged to me that he, in company with others, had made sufficient tests to indicate that the wheels were, since using the small nozzles, working up to the 80 per cent efficiency, but that they would not suit his purpose because they would supply power for the rated capacity of the generators only, while he exacted that they should also be capable of operating at 50 per cent overload capacity. I think that all engineers who work directly in the hydraulic power industry will agree with me that he is asking for something that he cannot get out of any type or principle of water wheel.

There is nothing in theory or practice that would indicate that there is the slightest falling off of efficiency of a spouting stream of water, no matter what velocity it attains. The only limit to the feet in head or pounds pressure at which a hydraulic equipment will work successfully and efficiently is that limit wherein the pressure cannot be contained in pipes, fittings and packed joints. I have used much water (for power purposes) under varied heads up to 500 lb. per sq. in. and have watched so much in connection with the Pike's Peak Hydro-Electric plant, whose pressure at times is 1,000 lb. per sq. in., that I have great confidence in high pressure, both in point of efficiency obtainable and of economy of construction. I court an opportunity of designing and constructing a power plant whose working pressure reaches 1,250 lb. per sq. in. To be sure, it is "hot stuff," but it is tame and subdued while it is perfectly confined.

There are many instances wherein efficiencies have been obtained better than 80 per cent, under working pressures of 800 to 1,400 ft. head. The only one that can be considered a parallel case to the one in question is that of the Edison Electric Company's plant near Los Angeles, in which is installed a 750-kw generator driven by a Pelton wheel, operating under 1,960 ft. head. In this installation George J. Henry, Jr., and Prof. N. LeConte, of the University of California, obtained an efficiency of 86.2 per cent, which test was fully described at the 179th meeting of the American Institute of Electrical Engineers, New York, September 25, 1903, pages 1511 to 1529 of the minutes.

In conclusion, I trust that my description will encourage your readers to investigate carefully before they are discouraged from applying water at any pressure obtainable so long as they use proper kind of materials for withstanding the pressure.

Denver, Col. R. M. Jones.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Single-Phase Motors.—Richter.—The conclusion of his very long illustrated article on the improvements which the Siemens-Schuckert Company is introducing in the design of single-phase series motors. The first part of the article, which has already been abstracted in the Digest, dealt with starting and commutation. The author now discusses the utilization of the material and says that for given dimensions and given permissible motor losses a relatively high capacity is obtained by the Siemens-Schuckert Company by using a relatively high ratio of pole arc to pole pitch, which may be, for instance, 0.875. This would not be possible with a similarly designed direct-current motor since for the same current density in the conductors the excitation winding would require 40 per cent more space. This gain in capacity amounts to about 10 per cent for the series motor of the Siemens-Schuckert Company. By using resistance wires which are connected between armature and commutator and which are placed in the slots, the motor capacity can also be increased by about 10 per cent in comparison with the otherwise usual arrangement. With constant losses and increasing capacity the efficiency of the motor also increases. The author finally gives the following comparison between the series motor of the Siemens-Schuckert Company and the compensated repulsion motor. Concerning starting, he says that when there are no resistances between armature winding and commutator, the starting operation is at least as good with a series motor as with a compensated repulsion motor. If a high starting torque is required, resistances must be inserted between the armature winding and the commutator in order to get a low starting current and small commutator losses with each type of motor. With the arrangement of resistances used by the Siemens-Schuckert works, however, these resistance wires are active armature conductors and therefore increase the starting torque by about 10 per cent without increasing the losses. Concerning commutation the author says that in the series motor of the Siemens-Schuckert Company the commutation voltage can be compensated for at all loads which is not possible with the compensated repulsion motor. In the series motor of the Siemens-Schuckert Company the e.m.f. of rest can be eliminated for almost all loads, while this can be done with a compensated repulsion motor only for a given speed. With the compensated repulsion motor the commutation of the excitation brushes is also to be taken into consideration while the series motor has no such brushes. Concerning utilization of the material the author gives some data showing that the series motor may be made of smaller dimensions than the repulsion motor. The efficiency of the series motor is claimed to be at least several per cent higher than that of the compensated repulsion motor. By special arrangement of the armature resistance wires on the Siemens-Schuckert motor, it is possible to get a power factor equal to unity for almost all loads and for almost all speeds. This is not possible with the compensated repulsion motor whatever may be the adjustment of the series transformer (according to Eichberg and Winter).—*Elek. Zeit.*, June 14.

Single-Phase Commutator Motors.—Niethammer.—A mathematical article giving formulas for calculating the iron losses in single-phase commutator motors.—*Elek. und Masch.*, June 10.

Single-Phase Motors.—Fynn.—The conclusion of his article on the classification of alternating-current motors. In the last installment he gives diagrams and brief descriptions of the various types of motors with shunt characteristics.—Lond. *Elec.*, June 15.

Lamps and Lighting.

Tungsten Lamp.—A summary of recent developments. The process of Just and Hanamen is based on the fact that if current is passed through a carbon filament in an atmosphere of $WO_2\ Cl_2$ containing very little hydrogen, so as to bring the filament to a high temperature the carbon filament is gradually changed into a tungsten filament according to the reactions, $WO_2\ Cl_2 + C_2 + 2\ H = 2HCl + 2CO + W$ or $WOCl_4 + C + 2\ H_2 = 4\ HCl + CO + W$. After the carbon has thus been replaced by tungsten, the amount of hydrogen gas is increased in the atmosphere and the tungsten filament is now being thickened and made uniform by the reactions $WO_2 + Cl_2 + 3\ H_2 = 2\ H_2O + 2\ H\ Cl + W$ or $WOCl_4 + 3\ H_2 = 4\ HCl + H_2O + W$. The process of Kuzel makes use of tungsten in a colloidal state, as has already been mentioned in the Digest. Some tests made by the Sirius Company on tungsten lamps consuming one watt per candle have shown a useful life of at least 1,000 hours, the average decrease of cp being not more than 10 to 15 per cent of the original value. The current for these tests was not taken from storage batteries but the supply current of a central station was used, so that the lamps were subjected to the usual difference of voltage. It is stated that the tungsten lamp has lately been gradually more and more improved. Of some recent tests the following may be mentioned which was made with a 30-volt, 13.5-cp, 0.470-ampere lamp:

Hours.	Hefner candle.	Amp.	Watts per hefner candle.	Change of c p in %
0	13.5	0.470	1.05	0
467	12.1	0.465	1.11	—10.4
1,460	12.0	0.470	1.09	— 4.4
2,188	13.5	0.470	1.05	0
3,103	14.0	0.480	1.03	+ 3.7

The lamp continues to burn; as in the case of a tantalum lamp the breaking of the filament of the tungsten lamp does not necessarily mean the end of its life, since the filament may automatically fuse together again. How little the tungsten lamp is affected by variations of voltage was shown by increasing the voltage of one lamp to 233 per cent the normal value without the filament burning through. The tungsten lamp consuming one watt per candle, is used at present only at low voltages (below 40). It is stated, however, that lamps for 110 volts are also being made, and that they may prove even more economical. Finally a new Austrian patent is briefly mentioned granted to J. Lux for preparing filaments of refractory metals.—*Zeit. f. Beleucht.*, June 10.

Colloids.—Lottermoser.—With reference to Kuzel's method of making filaments from colloids the author gives some general notes on the colloidal state.—*Zeit. f. Beleucht.*, June 20.

Frosting of Lamp Globes.—Solomon.—A communication referring to the recent article of Cravath and Lansingh. The low figures for the absorption produced by frosting and by holophane globe confirms the author's own observations. With respect to the remarkable effect of the frosted globe on the useful life, the author suggests that an explanation may be found in the fact that the lamps were not cleaned in any way during the experiments, he states on the authority of Legge and Townsend that merely wiping a clear lamp and shade can result in an increased light of nearly 30 per cent. It seems probable that the smaller surface of the frosted bulb, the fact that

it was probably much hotter than the holophane globes, and the fact that its rough surface soon gets dirty and discolored account for the difference in life. A repetition of the experiments should be made with careful cleaning of the lamps and globes before each photometry, "for, after all, the lamp manufacturer is expected to supply the public with good lamps, but not with good housemaids." In an editorial note there is a further proposal that the definition of the life of the incandescent lamps would seem to require a new factor to keep it in order. When lamps are compared on the basis of the useful life, it will be necessary to specify that a comparison shall be made on the assumption of a 100 per cent "dust-factor" or "housemaid's factor."—Lond. *Elec.*, June 15.

Power.

Elevators.—BUSHNELL.—An article on relative advantages of electric and hydraulic equipment of the elevator service in tall steel buildings. The hydraulic elevator was the first to become developed for passenger service and for a long time was preferred in high-class construction. Step by step, however, it has been driven from its position until to-day probably 90 per cent of the elevators sold for general use are electric. From statistics of the operating costs of a large number of elevators in Chicago the author concludes that the electric elevators have approximately twice the efficiency of hydraulic elevators using electric pumps. A drum-type electric elevator uses on the average 3 kw-hours per car mile, while a hydraulic elevator operated by means of electric pumps, consumes about 6 kw-hours per car mile. Further, for a medium sized plant the hydraulic equipment with a high-duty pump requires nearly double the investment required for the electric elevator where the energy for the elevator is obtained from a central station. The author believes that the electric elevator will almost entirely replace the hydraulic machine.—*Cassier's Mag.*, July.

Suction Gas Plants.—An illustrated description of the suction gas plants entered for the Royal Agricultural Society's competition at Derby. The competition lies between plants consisting of a suction producer and gas engine capable of developing from 15 to 20 hp maximum. They have to undergo full load trials of 9 hours and after having been shut down are tested at no-load for two hours. The different plants entering the competition are described and illustrated and details are given of the tests. "Taken as a whole it may be said that the engines run astonishingly well during the full-load trial." It is also said that the advent of the suction producer has enormously increased the demand for the internal combustion engine.—Lond. *Eng'ing*, June 22.

Electric Winding in Mines.—VALBRUEZE.—The first parts of an illustrated serial describing different systems for this purpose.—*L'Eclairage Elec.*, June 9, 16, 20.

Electricity in Mines.—A preliminary description of exhibits at the International Colliery Exhibition in London.—Lond. *Elec.*, June 15.

Electric Power in Sugar Plants.—BRUNSWICK.—The first part of an illustrated article on the use of electric power for various purposes in sugar plants.—*L'Industrie Elec.*, May 10.

Ore-Handling Machinery.—WILLEY.—A fully illustrated article on the latest ore-handling machinery on the great American lakes, electric power being used to a large extent.—*Cassier's Mag.*, July.

Utilizing Exhaust Steam.—RUBRICIUS.—A paper read before the Vienna Electrical Society. After a review of various methods on utilizing exhaust steam he dealt especially with the Rateau "heat accumulator."—*Elek. und Masch.*, June 29.

Traction.

Teltow Canal.—BLOCK.—Continuation and conclusion of his long illustrated article on the electric equipment of the Teltow Canal. Electricity is supplied from one central station which is equipped with steam turbines. Concerning the cost of electric towing the following figures are given for yearly traffic of 2,000,000 tons. The cost of the energy consumption of the locomotive is 0.0105 cent per ton-km. The consumption of oil on the boats (which are equipped with oil engines and haul boats over two lakes where towing is not possible from the banks) is 0.010 cent per ton-km. The cost of lubricating the locomotives and ships is 0.00125 cent per ton-km. Maintenance and wages, 0.02775 cent per ton-km; cost of maintenance of buildings and machines, 0.01775 cent per ton-km. Hence total cost of operation, 0.06725 cent per ton-km. Interest at 4½ per cent requires 0.045 cent, depreciation 0.01775 cent. Hence the total cost becomes 0.13 cent per ton-km. With a traffic of 3,000,000 tons per year the total cost becomes 0.10225 cent per ton-km. For a yearly traffic of 4,000,000 tons the toal cost is 0.0895 cent per ton-km. These figures are somewhat high, due to topographical difficulties, so that on the average the costs of electric towing should be somewhat less than stated above.—*Elek. Zeit.*, June 14 and 21.

Installations, Systems and Appliances.

Protective Devices Against Atmospheric Electricity.—MOSCICKI.—The author shows that when even small ohmic resistances or reactances are inserted in the earth connection of the spark gap of a high-frequency high-tension current (such as in atmospheric discharges), especially if water resistances with metallic electrodes are used, enormous voltage drops may occur which can produce a dangerous increase of the current. The author recommends as a substitute for the spark gap, an inductive resistance in parallel with an earthed series of condensers. With sufficiently good earth connection any serious increase of voltage and any dangerous increase of current may be avoided. An arrangement of this kind for protecting an electric plant, T, is shown in Fig. 1. The induction coils, L, and condensers, C_1, give sufficient protection against all moderate disturbances of an electrodynamic nature. The second series of condensers, C_2, which is connected in parallel with the self-inductance, L, serves for carrying off heavy discharges of high voltage and high frequency which break through one of the condensers, C_2. In series with every condenser a fuse, s, is provided in order to make the different condensers independent of each other in case of a break-down. The choking coils, d, in parallel with the condensers, C_1, serve for carrying off static charges in the line. All resistances should be avoided in the earth connection, and the earth plates should have a low transition resistance; this is best accomplished by moistening the earth in the neighborhood of the plates. The wires connecting the condensers and conductors and the earth wires should be as short as possible in order to reduce the resistance, and the author recommends the use of broad copper ribbons instead of the wires. Horn lightning arresters should never be connected in series with water resistances and should not be earthed in series on account of the dangerous increase in voltage mentioned above.—*Elek. und Masch.*, June 24; from *Schweitz E. T. C.*, No. 14 to 16.

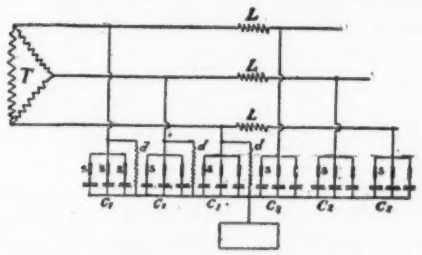


FIG. 1.—DIAGRAM OF PROTECTIVE SYSTEM.

British Central Station.—The first part of an illustrated description of the new Brighton municipal electric station. Brighton was one of the first English municipalities to embark on the business of electricity supply, obtaining its provisional order in 1883 and commencing in 1890 the contrusction of the works, which were opened in 1891. In 1892 the plant capacity was 300 kw and now it is 10,400 kw with the inclusion of the new Southwick works. The new works are situated on Shoreham Harbor, a distance of 4¾ miles from the old electricity station at Brighton. Electricity is generated there at 8,000 volts, three-phase, and is conveyed to a substation built as an annex to the old works. This is at present the only sub-station. The old engine room contains a collection of 15 machines of various makes and sizes of from about 50 kw to 500 kw output, and totalling 5,000 kw. The voltages are also various: 115, 230 and 460 volts for lighting, and 550 volts for traction. The traction generators are in a separate engine room. There is also a balancing transformer (175 amperes at 115 volts) which

has been running day and night continuously for over five years with only a brief interval of a few hours on one occasion when it was moved from one end of the engine room to the other. A 400-amp-hour storage battery is used for station lighting, and there is a 1,200-amp-hour traction battery worked through a reversible booster. The sub-station contains two rotary converters rated at 1,500 kw, and receiving current from step-down transformers. Pressure regulation is by means of an induction regulator.—Lond. *Elec.*, June 15.

Central Station Business.—Hammond.—Another of his series of articles on how to get new business for electric central stations. The author discusses the effect of advertising, soliciting and circularizing.—*Cassier's Mag.*, July.

Automatic Making Out of Bills.—Ritter von Molo. An illustrated description of apparatus for automatically making out bills from electricity meters and other meters.—*Elek. und Masch.*, June 24.

Safety Regulations.—Suering.—A report of the committee of the Berlin Electrical Society for drafting safety regulations for protecting powder magazines and other buildings in explosive factories against lightning.—*Elek. Zeit.*, June 14.

Wires, Wiring and Conduits.

Heating of Cables.—Teichmueller and Humann.—The phenomena which are of practical importance in the heating of underground or other cables can be followed by physical considerations, and the laws governing the heating can be easily given in mathematical form. The terms which enter into the formulas for the stationary flow of heat are dimensions (cross-section, diameter, depth of laying the cable), arbitrary figures (permitted increase of temperature) and constants which must be found empirically. The determination of these constants is the object of the researches of the authors. The theory of the heating of cables has given the following formula:

$$I = \frac{C}{\sqrt{n}\,r}\sqrt{\frac{Qt}{s_{kt}\log\frac{D_a'}{D_i'} + s_{nt}\log\frac{4l}{D_a}}}$$

where I is the current in amperes, $C = 16.52$, n number of the conductors in the cable, r the specific resistance of the metal of the conductor in ohms per meter per square millimeter at the temperature corresponding to the increase, t, of temperature (if $t = 25$ and the original temperature is 15° C., $r = 0.01925$), Q the cross-section of one of the n conductors in square millimeters, t the permitted increase of temperature in degrees C., s_{kt} the specific thermal resistances of the insulating and packing materials in electrical units of measurement, D_a' the "reduced" external cable diameter, D_i' the diameter of the conductor of the equivalent single-conductor cable (concerning these reductions reference is made to Teichmueller, *Elek. Zeit.*, 1904, p. 933 and Mie, *Elek. Zeit.*, 1905, p. 137), s_{nt} the specific thermal resistance of the earth in electric units of measurement, l the depth at which the cable is laid in the ground, and D_a the external cable diameter. The measurements of the authors show that s_{kt} varies in general between 550 and 650, while s_{nt} varies between 40 and 60. These figures agree well with other determinations.—*Elek. Zeit., June* 21.

Units, Measurements and Instruments.

Magnetic Testing.—Peake.—A note on a new instrument for obtaining the B-H curve of small samples of iron. The sample may be a strip of thin sheet iron 3 in. by ⅝ in., or a number of thin wires built up side by side to similar dimensions. It is placed in a cradle pivoted on a horizontal axis through the centre of gravity of the whole. Fixed to the lower part of the cradle is a balance weight and a vane working in a dash-pot, and to the top of the cradle is attached a long vertical pointer working over two scales. One of these scales is fixed with its zero mark indicating when the pointer and sample is vertical; the other scale is part of a frame that rotates about a horizontal axis at the level of and in line with the axis of the cradle carrying the sample. This movable frame carries a number of permanent steel magnets that, in the zero position, produce a uniform magnetic field truly perpendicular to the sample. If the frame carrying the magnets be rotated a little from the vertical, the field acquires a component along the sample of iron, magnetizes it and deflects it. The pointer indicates this deflection on the fixed scale, whose reading is thus a measure of the induced magnetization; and, besides, gives on the scale attached to the frame of the permanent magnets a reading that can be made a measure of the component field acting on the sample. The complete hysteresis curve of the sample can be very quickly obtained by increasing and decreasing the inclination of the fixed magnets step by step. Demagnetization of the sample is very easily effected by removing the dash-pot below the pointer and then setting the sample swinging in the horizontal field.—From *Proc. of Cambridge Phil. Soc.;* abstracted in Lond. *Elec.*, June 15.

Recording Speed and Uniformity of Speed of Revolving Machines.—Lux.—The frequency and speed meter of Frahm which has been repeatedly described in the Digest is said to have found considerable application in practice during the last years. Essentially it contains a series of tongues tuned to different frequencies. According to the speed the one tongue which is tuned to that special frequency begins to vibrate. The present author makes this instrument a recording one by photographic means. The light from a lamp is in general screened off by the tongues. When one tongue vibrates, however, a ray passes at that special point, and is recorded on a photographic paper. This method enables one to get records of the speed of machines as well as records of the degree of uniformity of speed during one revolution.—*Elek. Zeit.*, June 14.

Synchronizer and Power Factor Indicator.—Wattelet.—The first parts of an article describing, with the aid of diagrams, the principles of two instruments of the French Thomson-Houston Company. One is an indicator of synchronism and the other an indicator of the power factor.—*L'Eclairage Elec.*, June 16, 23.

Street Photometers.—An illustrated description of two street photometers, namely that of Harrison and that of Simmance-Avady.—*Zeit. f. Beleucht.*, June 10.

Interrupter.—Januszkiewicz.—A description of a new current interrupter for Roentgen apparatus, the special feature being that it works under a pressure of about three atmospheres.—*Phys. Zeit.*, June 15.

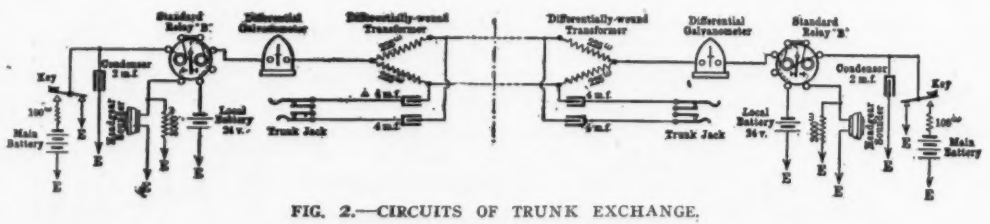


FIG. 2.—CIRCUITS OF TRUNK EXCHANGE.

Telegraphy, Telephony and Signals.

Trunk Exchange.—An illustrated article on the new telephone trunk exchange in Birmingham, the equipment of which follows in general that used in London for dealing with the trunk traffic passing in and out of the city. Two new features are said to represent a great advance; they are already partly supplied in London. The first is the employment of a telegraph circuit, superimposed on one of the trunk lines between the more important centers, which circuit fulfills analogus functions to the call wire in ordinary junction working and transmits all service communications, so that the trunk wires themselves, as a telephone circuit, are kept continuously employed. In some cases this has increased the earning capacity of a trunk line during the rush hours of the day to such an extent that it is carrying subscribers' messages and earning money during about 48 minutes of every hour, instead of only about 30 minutes.

The second is the use of a new type of time check, which indicates to an operator by a direct lamp signal when the three minutes allotted to a subscriber has elapsed without the operator having to watch the calculagraph record. The arrangement of the superimposed telegraph circuit is shown in Fig. 2. A differentially wound transformer is connected in bridge across the two-line wires, and the telegraph circuit is taken off from the middle point while the lines are connected to the trunk jack through 4 m.f. condensers. An ordinary telegraph key is used, arranged so that the sound is deadened, but the sounder which receives the signals is of special design. It is a diminutive sounder fitted in the case of an ordinary head-gear telephone, and covered with a diaphragm which has a hole in the center. The telegraph operator can thus hear the sounder distinctly, but it is inaudible to the other operators near. This operator sits between two operators' positions at which the trunk lines to the center in question terminate. She sits in front of a small board projecting from the main board, and this forms a desk and affords space for the key. In this way she is just behind the two operators and can give them instructions. All the service communications are exchanged between the two telegraph operators by means of special code letters to save time, and thus the subscribers at both ends of the line whose turn comes next to be put into communication are called while the preceding conversation is in progress, and no time is wasted.—Lond. *Elec.*, June 15.

Wireless Telegraph.—NAIRZ.—The first part of an illustrated serial on progress in wireless telegraphy.—*Dingler's Polytech.* Jour., June 23.

Miscellaneous.

Association of German Electrical Engineers.—The first part of a full report of the recent annual convention in Stuttgart of the Association of German Electrical Engineers. The speeches held on this occasion and the report of the general secretary, Dettmar, and of the treasurer are given. The Association has now 3,866 members.—*Elek. Zeit.*, June 21.

Association of German Engineers.—The first part of a report of the speeches and lectures held at the recent convention of the Association of German Engineers at which the 50th anniversary of the foundation of the Society was celebrated. The Association has more than 19,000 members. In the present installment the speeches of President Slaby, of the Secretary of State, Count Posadowsky-Wehner and of Dr. von Oechelhauser are given. The latter spoke on the development of engineering during the last 50 years.—*Elek. Anz.*, June 21.

Swiss Electrical Society.—An account of the first convention, devoted to papers and discussions, of the Swiss Electrical Society. Filliol gave notes on the technical testing laboratories in Zurich, especially on high-tension insulation tests, and on oscillograph records. Frank spoke on protecting devices for electric lines; Okoniewski on the application of the oscillograph for investigating alternating-current circuits. Thury gave a review of his well-known system of power transmission over long distances by means of the direct-current, high-voltage, constant-current series system. The largest plant of this kind is that of Montiers, where four groups of two 800-hp, 7,500-volt generators (total 6,400 hp at 60,000 volt) are employed for transmission to Lyons, the distance being 180 km. Wysling reported on his trip to the United States; he was especially impressed by the enormous size of some of the central stations and plants visited.—*Schweiz. E. T. Z.*, No. 13 to 18; abstracted in *Elek. und Masch.*, June 10.

Institute.—SIMON.—An illustrated description of the new institute for applied electricity at the University of Göttingen.—*Phys. Zeit.*, June 15.

Biographical.—A biographical sketch with portrait of the new president of the A. I. E. E., Dr. Samuel Sheldon.—*Cassier's Mag.*, July.

Blasting Apparatus.—MAURICE.—A continuation of his illustrated serial on electric blasting apparatus with special reference to its use in coal mines. In the present installment the author discusses the methods of connecting wires for shot-firing circuits and methods of testing.—Lond. *Elec.*, June 15.

Electrophysics and Magnetism.

Electric Field of the Atmosphere.—NORDMANN.—A summary of researches made in recent years on the electric field of the atmosphere. The author points out the fundamental importance of Elster and Geitel's proof in 1899 that there are permanently in the atmosphere free positive and negative charges, analogous to those which the radiations from radium and various other kinds of rays produce in gases. The author first described how the potential of a point in the atmosphere is generally measured. The earth taken as a whole is at a lower potential than the air around it, and it has been deduced therefrom that the earth carries a negative charge. This hypothesis has been proposed by Sir William Thomson and is generally accepted. It is possible, however, that this result must be interpreted in a different way. Instead of stating that the charge of the earth is negative, it may be that this charge is only apparent, and is due to the free positive electricity in the atmosphere. That the atmosphere contains free positive electricity has been proven experimentally and it is not impossible that the apparent negative charge of the earth is due at least to a large extent to the real positive charge of the atmosphere. The author then discusses the variation of the field in the atmosphere with the height from the earth. Experiments have established that the field diminishes with the height, which indicates that the atmosphere contains positive charges. There are in the air both free positive and negative charges, but the former are in excess. The daily variation of the electric field in the atmosphere is represented by a curve in the form of a simple oscillation with a maximum near 4 o'clock p.m. and a minimum near 5 o'clock a.m., so that the variation may be well represented by a sine curve with a period of 24 hours. After a discussion of the annual variation the author deals with the influence of accidental phenomena on the electric field in the atmosphere, especially the influence of rainstorms and the remarkable effect of an eclipse of the sun. In the conclusion of his paper the author shows briefly how the consideration of the pressure of free ions in the atmosphere has modified our ideas on the electric field of the atmosphere and its various peculiarities. He gives an outline of the theories of Elster and Geitel, of Ebert and of Gerdien.—*Revue Gen. des Sciences*, May 30.

Radioactivity.—A paper by Rutherford and Boltwood refers to the fact that the amount of radium in a mineral is always proportional to its content of uranium. The constant of proportionality is of considerable practical and theoretical importance. From the present investigation of the authors it follows that the quantity of radium associated with one gram of uranium in a radioactive mineral is equal to approximately 3.8×10^{-7} gram. On the present basis the ores of uranium per ton of 2,000 lb. will carry about 0.0034 gram of radium for every per cent of uranium present. A ton of 60 per cent uranium ore will, therefore, carry about 0.20 gram of radium equivalent to 0.35 gram of radium bromide. The same issue contains a paper by Eve on the measurement of radium in minerals by the gamma radiation, and a paper by Levine on the absorption of the alpha rays from polonium.—*Am. Jour. of Science*, July.

Fluorescence.—WOKER.—A paper on the theory of fluorescence and especially on the relation between fluorescence and color. The fluorescence of a substance can be decreased or destroyed by a complementary coloring. It is immaterial whether the coloring is due to the compound itself or to impurities. The visible fluorescence is usually decreased by the introduction of chromophoric groups: (*a*) because the chromophore determines the color and may decrease the fluorescence by producing a complementary color; (*b*) because the chromophore displaces the absorption bands towards the red end of the spectrum, thus decreasing the possibility of fluorescence. Salt-forming groups affect fluorescence, usually unfavorably. They displace the absorption bands towards the red end of the spectrum except in a few cases, such as the hysochrome amino group for instance, which, as a matter of fact, increases the fluorescence. They often re-enforce the coloring effects of the chromophores. They increase the effect of the chromophores in displacing the absorption bands towards the red end of the spectrum. This increased effect is more marked the nearer the chromophore and the salt-forming groups. The same is true for the mutual effect of two salt-forming compounds. The latent fluorescence, characteristic of all benzine derivatives, can be made visible by the same means which decrease the visible fluorescence, namely, by the introduction of chromophores and salt-forming groups.—*Jour. of Phys. Chemistry*, May.

BOOK REVIEWS.

MANUALE DELL INGEGNERE ELETTRICTISTA. By Attilio Marro. Milan: Ulrico Hoepli. 689 pages, 192 illustrations. Price, 7.50 lire.

This is a new Italian electrical handbook dealing with standard subjects, but in many respects original in giving up-to-date data as, for instance, for the design of electrical apparatus, transmission lines and distributing systems. It gives the regulations and legislation governing the installation and operation of electrical enterprises in Italy and other European countries. The book is neatly printed and bound, and is one of the series of the well-known Hoepli handbooks.

THE ELEMENTS OF ELECTRICAL ENGINEERING. A text-book for technical schools and colleges. Vol. I, Direct-Current Machines—Electrical Distribution and Lighting. By Prof. W. S. Franklin and Prof. William Esty. New York: Macmillan Company. 368 pages, illustrated.

Vol. I of "The Elements of Electrical Engineering," by Professors William S. Franklin and William Esty, both of Lehigh University, is just from the press, and concerns direct-current machines, distribution and lighting, while the second volume will discuss alternating-current machinery and distribution. The word "dynamo" is consistently used to cover all forms of machines for converting mechanical into electrical energy, and the differences between these machines used as generators or as motors are shown to be confined to controlling apparatus, or to the point of view of a given problem. Intended primarily for those first entering upon the study of direct-current dynamos the book is written in such a clear, direct style as to attract the expert as well as the novice. Difficulties are not slurred but surmounted, and even the simplest points are given with such freshness and conciseness as to command the attention they deserve.

The opening chapter takes up electromotive force in a novel way, defining it as P/I, or as the ratio of power to current. Unfortunately, the ambiguity of the term "power" detracts from the value of this innovation. The fundamental equation for the electromotive force of a dynamo depending on magnetic flux, speed and conductors, is derived at once for the multipolar machine, and leaves no uncertainty as to the question of series or parallel connections of the armature coils. The points of similarity and of difference between ring and drum windings are given with admirable clearness. Dynamo connections are shown both by plans of wiring and by conventional diagrams, the latter being so clearly given as to be truly artistic. Many texts imply, if they do not state, that a two-circuit multipolar armature has but two sets of brushes, when this condition is merely a possibility of this form of winding. The authors here state "In any closed coil winding whatever there are p neutral points around the commutator, and p brush sets may be used in any case," p being the number of poles. This statement is an illustration of the care with which points of practical importance are made. The chapter on armature windings gives usual types with remarkable clearness, but omits "freak" windings.

A chapter on details of construction, such as insulation, brush holders and commutators, while not intended as a guide for dynamo design, enables the student to grasp standard methods of utilizing the principles enunciated. Typical examples only are given, the confusion of alternative methods being avoided. A chapter on ratings and guarantees shows what manufacturers are called upon to furnish, and a discussion is given of comparative costs. Commercial methods of testing are given, following logically on the principles established. Operations in parallel and in series, as for the Edison three-wire system, are well shown, giving the student just the points underlying the work of the switchboard attendant. Characteristic curves are treated in a manner to make these curves pregnant with the information that may be derived from them, instead of a mere record of uninteresting data, too often looked upon as of no practical value.

The problems are clever in their instructional vaiue, being as far removed as possible from mere arithmetical questions. They are a feature of the book. A concise account of the usual types of measuring instruments is included.

The book is an excellent example of fine typographic art, and is almost entirely free from the errors that usually mar a first edition. It is well adapted for general use in classes just entering upon electrical engineering, and merits a place in all electrical libraries.

Fuel Consumption of Oil Engines.

The curves on the accompanying diagrams, for which we are indebted to the American Diesel Engine Company, were plotted from data obtained from Diesel oil engine plants in regular operation covering a considerable period of months. As is well known, this type of engine operates on the four-stroke cycle principle. During the first, or admission, stroke the piston draws in a full cylinder of pure air. During the second stroke this pure air is compressed to such a high point that the temperature, due to compression, is sufficient to ignite any

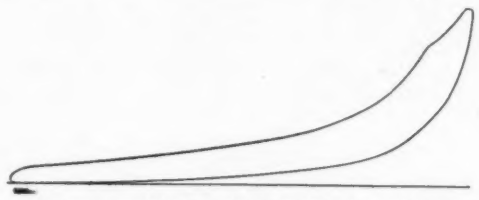


FIG. 1.—INDICATOR CARD FROM OIL ENGINE.

liquid fuel injected into it, thus doing away with all ignited systems. At the top of the second stroke a charge of crude or fuel oil, distillates or even water-gas tar in a finely atomized state is injected into the intensely heated air, by a jet of highly compressed air from an auxiliary reservoir. The third, or power stroke is taken up with the gradual burning of the fuel—as fast as it enters the combustion chamber—and the expansion of the burned gases; while the fourth, or exhaust, stroke scavenges the cylinder. The variation in pressure acting on the piston during operation can be learned from Fig. 1, which shows a typical indicator card. It will be noticed by reference to Fig. 2 that the fuel consumption and cost per hp-hour is very low at

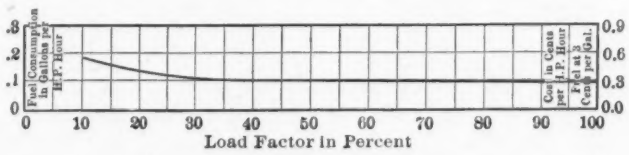


FIG. 2.—FUEL CONSUMPTION AND COST.

full load with only a very slight increase as the load factor decreases.

The governor acts on the oil pump of each cylinder, to regulate the amount of oil injected at each power stroke. It is stated that the speed regulation of the Diesel engine is equal to that of the best types of steam engines as the pistons receive no sudden impulses, back firing is impossible and the three cranks acting at angles of 120 degrees with each other maintain a constant torque on the crank-shaft. It may be of interest to note that in several recent, large installations Diesel oil engines are running alternators in parallel.

Equipment for Steel Plant at Gary, Ind.

With the publication of the first account of the huge new steel plant of the Indiana Steel Company, Gary, Ind., comes the announcement of contracts placed for the power equipment for its operation. Nine mammoth Allis-Chalmers gas engine generator units have been ordered, each with a normal rated capacity of 2,000 kw, to be installed in a central power plant, and to be operated from blast furnace gas. These engines are standard design, horizontal twin tandem, direct-connected to Allis-Chal-

mers alternators, 25 cycles, three-phase. Some idea may be had of the size of the Gary plant, for which these engines will furnish the electrical power, when it is realized that it will be the largest single steel plant in the world. It is expected that ultimately 15,000 men and boys will be employed in the works, and that the population of the town, which is to be built about the new mills, will grow to 100,000. The site covers 6,000 acres of land lying north of the Grand Calumet River, of which the plant will actually occupy approximately 1,280 acres, or two square miles.

Gas engines thus far purchased from the Allis-Chalmers Company by the United States Steel Corporation will have an aggregate normal capacity of 68,000 hp and represent a value of over $2,000,000. The contract for the Gary engines covers one of the largest single orders ever placed in this country or abroad, for gas engines, to be used either in blast furnaces or as prime-movers for electric generators.

Cord Grip for Sockets and Handles.

An effective and simple form of "grip" for electric cords and handles has been introduced with great success by Keough Bros. & Co., of 79 North Street, Boston, Mass. As will be seen from the sectional view here shown of the device or principle applied to a cord grip handle, a loosely revolving ball—of porcelain—applies the pressure so gently, yet so firmly, that it "stays put" without the necessity of any knot or other braking appliance. It is intended for use with any size of reinforced cord, and for attachment to ⅛-in. sockets. The arrangement prevents the

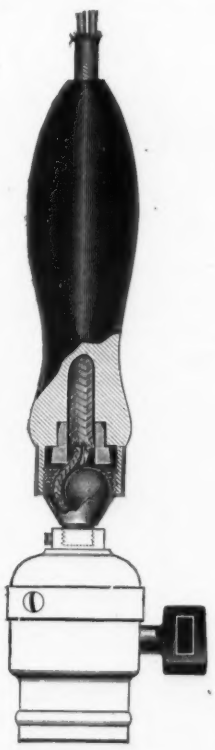


FIG. 1.—GRIP HANDLE.

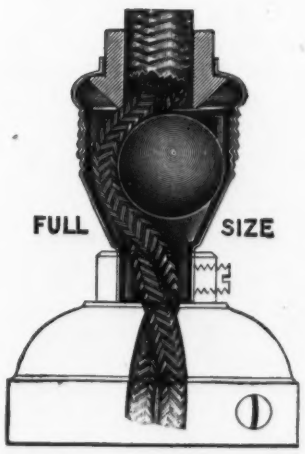


FIG. 2.—CORD GRIP AND REINFORCED CORD.

cords very effectually from being pulled from their terminals, which is a common occurrence with rough usage.

The cord grip, involving the application of the same simple mechanism, is also intended for attachment to the ⅛-in. socket and for use with reinforced cord. The device gives a positive, firm grip, and does away with the dangerous practice of knotting the cord under the socket cap, to hold it rigidly in place, and often causing short-circuits. The device is attachable to ⅛-in. threads in bracket rosettes, pendant switches, etc., and when used with the new reinforced cord it adds nothing to the cost of the installation, as it renders unnecessary the use of a ⅜-in. socket. The appreciation of the device by the trade is shown in the large repeat orders that are already being received for it.

Ventilating the New York Custom House.

One of the most complete heating and ventilating systems to be found in the country is that installed in the new U. S. Custom House now under construction in New York City. This is a large seven-story building, on the Bowling Green, occupying a lot 300 ft. long by an average of 240 ft. in width. With the exception of a small portion, an indirect heating system is used throughout. The corridors are heated by the special secondary utilization of the air after it has passed through the offices and rooms of the building, and will thus serve, with the elevator shafts, as vent outlets for all rooms heated.

On account of the size of the building the heating and ventilating system was for convenience divided into four independent divisions, each serving a section of the building adjacent to one corner. Each division has an independent blower and duct system, together with air washing apparatus, tempering and heating coils, and duct work. The blowers, of which there are four, furnished by the B. F. Sturtevant Co., of Boston, Mass., are ¾ housing, peripheral discharge, steel plate fans with 12-ft. wheels, 6 ft. in width. Each fan has a capacity of 100,000 cu. ft. of air per minute, at 140 revolutions. They are belt driven by electric motors and deliver into ducts or cases measuring 6x7 ft. in cross section. The heating coils, also furnished by the B. F. Sturtevant Co., are controlled by thermostats. Very novel and interesting features are introduced in the way of spray chambers, tempering coils and re-heaters, dry chambers and arrangements for avoiding back drafts to the rooms, etc.

The Demand for Apparatus in South America.

That there is a healthy demand for electrical machinery in the southern continent is well shown by several activities in Peru and Brazil. The Empresa Electrica de Santa Rosa, Peru, which already operates a large generating station on the River Rimac, is extending its service to such a degree that an additional power house is necessary. This will be operated in parallel with the present station. The equipment for the new station includes two three-phase, 60-cycle, revolving-field, alternating-current generators, each having a capacity of 1,200 kw. and operating at 2,300 volts. The generator voltage will be stepped up in three 750-kw, water-cooled transformers to 33,500 volts, and transmitted to a sub-station where distribution will be made from water-cooled step-down transformers at 2,300 volts. The electrical equipment including generators, transformers, switchboards and auxiliary apparatus has been ordered from the General Electric Company.

In Brazil, the Sao Paulo Tramway Light and Power Company is also making additions to its present equipment. At the generating station, another General Electric three-phase, revolving-field, 2,000-kw, 2,300-volt generator is about to be installed with necessary switchboards for the operation of the new machine. In addition, the equipment will be increased by three 60-cycle, 666-kw, 24,000/2,000-volt transformers, and three 60-cycle, 666-kw, 20,000/2,300-volt transformers of the same type. This power house furnishes current for the electrical triumvirate railway, light and power; and the railway equipment is being increased by ten double motor car equipments, and one four-motor equipment.

Another interesting installation about to be made in Peru is at the mines of the Inca Mining Company. The location of the properties of this concern makes transportation very difficult, and all material has to be packed up the mountain trails on mules. The electrical equipment includes a three-phase, 200-kw, 6,600-volt alternating-current generator of the revolving-field type. In addition there will be four 67-kw transformers as well as several induction motors for hoisting work and the necessary switchboards. The complete equipment will be furnished by the General Electric Company. In order to facilitate transportation all the apparatus will be constructed in parts, none of which will weigh over 350 pounds, except the alternator shaft. The work of assembling the machinery will be done at the mines.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The week was broken by the Fourth with its natural result of interfering with the continuity of business. Consequently the volume of business was smaller than during the preceding week, but general conditions were as firm as ever. Inventories are being taken and repairs made in industrial plants, but the bright prospects continue unimpaired. Fall orders are in good volume, and crop conditions, on the whole, are very favorable. Pig iron displays more firmness and considerable business has been booked, while finished lines are in an excellent position, demand from the railways continuing to be most marked. Labor is scarce, not only in the crop-growing regions, but in the industrial sections as well, the paucity of help curtailing production of Pennsylvania coke. Railway earnings are still very heavy, the indicated gain in gross receipts for June, as compared with the same month in 1905, being no less than 14 per cent. The past fiscal year was the best ever experienced by the railways, and the outlook is for a gain of 12 per cent or more in gross earnings. Failures are down close to the minimum for the first half of the year, being 7.4 per cent fewer than a year ago, while liabilities are 5.7 per cent smaller than last year, and only 17 per cent above the smallest total for nearly twenty years. The failures during the week ending July 5, as reported by *Bradstreet's* numbered 134, against 146 in the week previous, and 127 in the corresponding week last year. Six months' clearings at ninety-four cities aggregate $79,628,713,524, the largest total ever recorded in any six months, and 12.6 per cent larger than a year ago. Bessemer and basic irons continue in good demand, the supply of the former being as small as heretofore. On that account the leading interest purchased during the week about 12,000 tons of heavy steel scrap, although the general market for scrap continues to lag. New tonnage booked within the week for rails for 1907 delivery approximated 150,000 tons, and negotiations are going on for the sale of 140,000 tons for export, the only question being whether deliveries can be made to suit the wishes of foreign customers. Orders for all heavy lines of finished goods continue of marked proportions, demand for bridge work being a feature. Copper is dull and lower. Leading producers have figured that the increase in copper production this year will not be much in excess of 6½ per cent or about the same as last year, while consumption will show a much larger increase in proportion. Shipments of copper to Europe this year will be much smaller than in the preceding year, but the average valuation per pound will be larger. The closing quotations are 18⅝ for Lake, 18⅜ for electrolytic and 18 3/16 for casting stock.

LARGE STOKER EQUIPMENT.—The Philadelphia Rapid Transit Company has recently placed orders with the Westinghouse Machine Co., of Pittsburg, for a complete equipment of Roney mechanical stokers for its large subway power plant now building in Philadelphia. This plant was constructed for turbine machinery, and Westinghouse-Parsons turbines of 6,000 kw capacity will be installed. The order covers stokers for the entire boiler plant of 32,700 hp. Boilers are of the Parker water tube type. The New York, New Haven & Hartford R. R. Co. recently adopted mechanical stokers for its large power plant at Cos Cob now building to serve the electrified section of its New York City Terminal. The initial order comprising twelve stokers was recently placed. These stokers will serve twelve 520-hp Babcock & Wilcox water-tube boilers. The United Railways & Electric Co., of Baltimore, which has recently put in operation one of the most modern and efficient boiler plants in this country, has had sufficient successful experience with mechanical stokers as to result in recent extensions of its plant. The boiler house is double decked, and three new batteries on the second tier are now being installed. This plant is the largest steam plant in Baltimore, and passed through the Baltimore conflagration without damage, although the adjacent engine house was destroyed. A large order for mechanical stokers has also been received from the American Steel & Wire Co., Pittsburg, covering equipments for 19 boilers.

CABLES FOR ALASKA.—The specifications for the extension of the Alaska cable in the southeastern part of the territory are now ready, and will be distributed to prospective bidders. It is expected that the cable manufacturers will have the material ready in about three months, and Gen. Allen, the chief signal officer, believes that the extension to Wrangell and Ketchikan will certainly be laid during the coming autumn. The cable extension will cost about $130,000. The current army appropriation bill appropriates $179,000 for the improvement of the Alaska telegraph system, and the balance of $49,000 will be used in improving the land lines. It is probable that some of the routes will be slightly changed if the danger of breakdowns from weather conditions in the interior can thereby be reduced to the minimum. The war department has decided not to land the cable at Petersburg, where the connections are not of the best, but to cut in on the present cable at a point in Frederick Sound, near Cape Fanshaw, extend the line to Wrangell, thence to a point on Prince of Wales Island near Madley, and thence to Ketchikan, which will be the Southern terminus.

ALLIS-CHALMERS TURBO-GENERATOR FOR WILMINGTON.—The Interstate Railways Company, of Philadelphia, Pa., has made the purchase of new power equipment for the Wilmington & Edgemoore Electric Railway Company, Wilmington, Del., consisting of a 500-kw Allis-Chalmers steam turbine and alternator and a 40-kw Allis-Chalmers generator for direct connection to a 10 x 10 Ideal engine. The turbo-generator unit is a 2,300 volt, two-phase, 60 cycle machine, operating at a steam pressure of 140 pounds and producing its rated output at 100 per cent power factor with a 40 degree rise in temperature of the generator. Units similar to this are now on order for the Meriden Electric Light Company, of Meriden, Conn.; Canton Light, Heat & Power Company, Canton, Ohio; Western Gas & Electric Company, of Aurora, Ill., and the City of Jacksonville, Jacksonville, Fla. The standard Allis-Chalmers construction is followed. The turbine and alternator rotors, each carried in two bearings, will rest on a continuous bed plate, which is provided with suitable slides to allow for the expansion and contraction of the turbine cylinder, and in order to preserve the alignment of the entire unit.

CONSOLIDATION AROUND ELMIRA, N. Y., is about to take the place of the Chemung County Gas Company, the Elmira Water, Light & Railroad Company and the Glen Route. Another deal provides for the supply of all power for the proposed Elmira, Corning and Waverly line, of the Glen Route of the local car lines, as well as factory and lighting power for Elmira from the local power station of the Elmira Water, Light & Railroad Company. The Chemung County Gas Company is the company that furnishes natural gas to Elmira on an arrangement with the Potter Gas Company. The Glen Route is virtually owned by the Elmira Water, Light & Railroad Company. The Elmira Water, Light & Railroad Company is owned jointly by local interests and Bertram, Storrs and Griscom, of New York. The consummation of this negotiation will put under one head the management of all of Elmira's surface railroads, including the Glen Route suburban line, all of the natural and artificial gas business for lighting, heating and power, all of the electric power for lighting and power, and the water-works system.

THE COS COB POWER PLANT.—It is now within the range of probability that the first single-phase electric train will run on the New York, New Haven & Hartford Railroad between New York City and Stamford, Conn., before the summer is over. The latest reports from Cos Cob, where the electric power station is now being erected by Westinghouse, Church, Kerr & Co., who have charge of the construction of that building, are to the effect that everything is now about ready for the reception of the first instalment of electrical machinery. The latter is being pushed at the Westinghouse works in East Pittsburg with the utmost expedition, and the first generator is already in the testing department. The initial installation of apparatus will have a capacity of 13,000 hp, consisting of Westinghouse-Parsons steam turbines and Westinghouse alternating-current, single-phase generators. Of the thirty-five locomotives, which will be operated on the road to begin with, the first are also now undergoing practical tests on the Westinghouse Inter-Works Railway at East Pittsburg.

ORDER FOR RIO DE JANEIRO.—The largest hydraulic power installation in the Southern American continent is now being erected on the Rio Das Lagas River for the purpose of furnishing electric energy to operate street cars, electric lighting and manufacturing plants in the City of Rio De Janeiro. The plant will have an initial capacity of 40,000 hp, and all the machinery to equip the plant is being manufactured in the United States. It is the largest single order for electrical machinery which has ever been placed in this country for shipment abroad, and it is being furnished by the Westinghouse Electric & Manufacturing Company, through their export department. The corporation is the Rio De Janeiro Tramway, Light & Power Company, of Rio De Janiero, Brazil. It has a capitalization of $25,000,000, to be used in the development of the plant. The main power house is located at Rio Das Lagas on the Das Lagas River, where a head of about 960 feet will furnish the water power to run six Escher-Wyss water turbines that are direct-connected to electric generators.

THE AUTOMATIC ELECTRIC COMPANY, Chicago, is furnishing work on its new plant, a duplicate of the present structure in size and construction, and an administration building, which will separate the two. The manufacturing building will be 85 x 165 feet, six stories and basement, and the administration building 48 x 48 feet. With the addition of the new building and the space afforded by the removal of the offices, the manufacturing capacity of the plant will be increased 300 per cent. A contract for ten automatic screw machines has already been placed with the Brown & Sharpe Manufacturing Company, Providence, R. I., and for 14 polishing lathes with the Northern Electrical Manufacturing Company, Madison, Wis. A large amount of other machinery, such as punch presses, drill presses, etc., will also be installed. The company takes power from the Chicago Edison Company and will not therefore need a generating equipment.

PRICE OF TANTALUMS.—Mr. F. W. Willcox, of the Harrison lamp works of the General Electric Company, writes us as follows: "In your issue of July 7 on page 9 you have a reference to the European tantalum lamp, making a special of the fact that a large reduction in price has lately been made in these lamps in Europe. The price you state in England of 2 shillings 9 pence is equivalent to 66 cents American money. In your interest in noting this European reduction you overlooked the price which the General Electric Company has recently made on these lamps in this country, which is even lower than the price quoted by you as used abroad. The General Electric tantalum lamp is now offered to the public at 60 cents in lots of 500 for either immediate or future delivery. I think proper credit is due the American manufacturer for thus making a lower price than is quoted abroad on this new lamp."

RECENT CROCKER-WHEELER SALES.—The Crocker-Wheeler Company, of Ampere, N. J., reports among its recent sales the following machines: Twenty-one direct current motors ranging from 6 to 75 hp, sold to the National Tube Co., of McKeesport, Pa. One 500 kw direct current generator to Pensacola Electrical Terminal R. R. Co., of Pensacola, Fla.; 100 kw alternating current engine type generator, three-phase, 60 cycle, 240 volt and one 6½ hp exciter, 125 volts to the American Multigraph Company, of Cleveland Ohio, to furnish power for the motors and lamps in its new factory at Cleveland; one 75 hp, 115 volt, direct current motor to the New Jersey Zinc Company, Franklin Junction, N. J.

CROCKER-WHEELER GENERATOR SETS.—The Crocker-Wheeler Company, of Ampere, N. J., has sold to the Emfield Construction Company, of Windsor Locks, Conn., two alternating current generators of the following capacities: One coupled type generator, 180-kw, three-phase, 60 cycle, 2,300 volt, and one belt type generator, 165-kw, three-phase, 60 cycle, 2,300 volt. The Warwick Iron & Steel Company, of Pottstown, Pa., has purchased a 150-kw direct-current generator to operate at 250 volts, for shop equipment; and the Denver Dry Goods Store, of Denver, Col., has bought a direct-current generator of 300 kw, 120 volts, 160 r.p.m.

AMERICAN TELEGRAPHONE PLANT.—Work has been begun on the establishment of a manufacturing plant for the American Telegraphone Company at Wheeling, W. Va. The financing is in the hands of Charles K. Fankhauser & Company and the Sterling Debenture Corporation of New York City. Since the first announcement of Poulsen's invention of the electro-magnetic "recording and speaking telephone," American experts have been working on the perfection of the instrument for commercial purposes. This has now been accomplished, and the company expects to be in a position to meet the demand for telegraphones.

CENTRAL KENTUCKY TRACTION.—It looks as though Kentucky would soon see some extensive trolley construction. By amended articles of incorporation of the Central Kentucky Traction Company the company is given the right to construct 194 miles of traction lines from Lexington, Frankfort and Nicholasville, to county seats in central Kentucky. It is proposed to build from Frankfort to Owenton, Shelbyville and Lawrenceburg; from Nicholasville to Harrodsburg, Lancaster and Danville; from Winchester to Mount Sterling, and from Paris to Cynthiana. By the completion of these lines Lexington will be connected with every county seat in central Kentucky.

SALES OF GENERATING SETS.—Recent sales of generating sets have been made by the B. F. Sturtevant Company, Boston, Mass., to Charles El Ring, Brooklyn, N. Y.; John H. Bromley, Essington, Pa.; for yacht "Harriet;" Henry Steers, Inc., New York City; Burlee Dry Dock Company, Port Richmond, S. I. The company has also recently booked orders for generating sets with its new type vertical, enclosed, forced lubrication engines, for the following parties: Maryland Steel Company, Sparrows Point, Md.; D. L. Mayers, Grafton, W. Va.; Tintern Manor Water Co., Long Branch, N. J.

AUTOMATIC ELECTRIC ACTIVE.—An official of the Automatic Electric Company says: "For the first five months of this year we have completed and are installing 11,000 lines; we are building 24,000 lines, and have contracts for 18,000 lines. We shall this year reach the 75,000 and perhaps the 100,000 mark. One of the largest contracts recently received is for the equipment of the Home Telephone Company, of San Francisco, the issued rate installation to be for 10,000 lines. We are about to close a contract with one of the largest independents in the East for 20,000 lines to replace their second manual equipment."

PLANT FOR BATAVIA, N. Y.—Mr. R. M. Walker, secretary of the Genesee County Electric Light, Power & Gas Company, of Batavia, N. Y., informs us that the company has contracted for four 333-kw transformers from the Westinghouse Electric & Manufacturing Company and intends to supply the entire county of Genesee with Niagara energy for lighting and motor purposes. It expects to be able to do this about October 1.

W. S. BARSTOW & COMPANY, of New York City, have been engaged as engineers for remodelling the plant of the Jamestown Worsted Mills, Jamestown, N. Y. Plans will be drawn covering an extensive addition to the power plant and the plant will be changed over to an electric motor drive throughout. Barstow & Company recently completed a similar installation for the Hartford Carpet Corporation, Thompsonville, Conn.

CALCULAGRAPH IN JAPAN.—The Calculagraph Company of New York has introduced its timing machines successfully into Japan. The Japan Porcelain Company of Noritake, which ordered a calculagraph through Morimura Brothers, followed this by ordering three more, and speaks highly of the effect obtained in stimulating the workmen and in increasing production.

WORK AT MEMPHIS, TENN.—Construction has begun on the power house of the Electric Light & Power Company, financed by the Laclede Gas Light Company, of St. Louis. The new company is capitalized at $1,000,000 and will compete with the Memphis Gas & Electric Company.

Financial Intelligence.

THE WEEK IN WALL STREET.—Liquidation was heavy in the early part of the week, but after the holiday (July 4) there was a partial rally, the market finally becoming dull and somewhat irregular in its tendencies. The weakness of such important stocks as Reading, Pennsylvania, the United States Steel issues and Amalgamated Copper caused some nervousness, but no panicky feeling was evident. The electric and traction stocks were all weak and closed at lower quotations. Allis-Chalmers common dropped off a fraction, closing at 17½, while preferred lost 8¼ points, closing at the lowest figure of the week, viz., 45¾. General Electric was the exception and made a gain of 2¾ points, closing at 164. Westinghouse declined 3¾, the closing quotation being 150¼, which was also the lowest of the week for that stock. Brooklyn Rapid Transit is down ⅛-point, and Metropolitan Street Railway 1 point, the closing quotation being 75 and 105, respectively. Interborough-Metropolitan common closed at 37, a net advance of ¾, and preferred at 73½, a loss of ½-point. Western Union made a gain of ⅝, closing at 92, but American Telephone & Telegraph lost 1¾, the closing price being 132½. New York & New Jersey Telephone closed at 120; Electric Storage Battery 86, asked; American District Telegraph

30 and American Telegraph & Cable 90. Mackay Companies, both common and preferred, made a gain of 2 points each on the curb market, the closing quotations being 72½ and 73, respectively. Prices on the curb followed the lead of the Stock Exchange list and were extremely weak for a time. Following are the closing quotations of July 9:

NEW YORK

	July 3	July 9		July 3	July 9
Allis-Chalmers Co.	17⅛	16¾	General Electric	161½	163
Allis.Chalmers Co. pfd.	50	47⅞	Hudson River Tel.	...	...
American Dist. Tel.	30	30	Interborough Rap. Tran.	...	...
American Locomotive	65⅛	67	Mackay Cos	70	72½
American Locomotive pfd.	113	113	Mackay Cos pfd.	69¾	72
American Tel. & Cable	90	90	Marconi Tel.	...	...
American Tel. & Tel.	133	132	Metropolitan St. Ry.	...	...
Brooklyn Rapid Transit.	74¼	74⅛	N. Y. & N. J. Tel.	...	...
Electric Boat	25	25	Western Union Tel	91¼	92
Electric Boat pfd	70	70	Westinghouse com.	152⅛	150
Electric Vehicle	10	10	Westinghouse pfd.	...	...
Electric Vehicle pfd.	16	15			

BOSTON

	July 3	July 9		July 3	July 9
American Tel & Tel.	133¾	131	Mass. Elec. Ry. pfd	...	69½
Cumberland Telephone.	116¾	...	Mexican Telephone	...	...
Edison Elec. Illum.	242½	240	New England Telephone	...	130¾
General Electric	162	...	Western Tel. & Tel	12	...
Mass. Elec. Ry.	18½	..	Western Tel. & Tel pfd.	...	...

PHILADELPHIA

	July 3	July 9		July 3	July 9
American Railways	51¾	52	Phila. Electric	7⅜	7⅛
Elec. Co. of America	11½	11¼	Phila. Rapid Trans.	24½	25
Elec. Storage Battery	68½	68	Phila. Traction	...	99
Elec. Storage Battery pfd.	...	..			

CHICAGO

	July 3	July 9		July 3	July 9
Chicago City Ry.	160	165	National Carbon	85	85
Chicago Edison	...	...	National Carbon pfd.	118	118
Chicago Subway	..	45¾	Union Traction	...	...
Chicago Tel. Co.	...	...	Union Traction pfd	...	...
Metropolitan Elev. com.	27	26			

* Asked

NORTHERN WESTCHESTER SECURITIES.—Financial interests represented by Parker, Hatch & Sheehan were incorporated in Connecticut on July 5 under the title of the Northern Westchester Securities Company, with a capital of $2,400,000. The application was signed by F. A. Stratton, Charles H. Werner and Louis B. Grand, and declares that the object of the company is to acquire and own the stocks, bonds and other securities of public service corporations. Mr. F. A. Stratton was formerly president of the Westchester Lighting Company, and the new corporation, according to report, is to take over this concern and the principal gas, electric and traction companies in the northern section of Westchester County and in the eastern counties of Connecticut. The Parker, Hatch & Sheehan interests are heavy owners of New York State public utilities securities, and last Spring organized a traction, gas and electric holding corporation to take over the securities of a number of companies in the northern and western sections of the State.

KEYSTONE TELEPHONE EARNINGS.—The Keystone Telephone Company, of Philadelphia, has just completed the first full fiscal year under the present management, and the report for eleven months confirms that the earnings for the year ended June 30, 1906, will show a surplus of about $80,000 over the $200,000 interest on the $4,000,000 bonds. This is a substantial margin of surplus, and, inasmuch as this was shown after setting aside $78,000 for renewals in addition to operating expenses and taxes, the final result may be taken as quite conservative. The operating expenses were on a basis of 55 per cent of gross earnings, which was a basis more liberal than used to obtain. The gross earnings for the year have reached nearly $825,000. The May charges for renewals are on a basis of 21,250 telephones. At the close of 1905 the company had about 19,000 telephones installed, and the management then expressed a wish to make a gain of 6,000 in 1906. Something like 2,250 has been the gain in the first six months, a rate of 5,500 for the calendar year 1906.

TELEPHONY IN DETROIT.—The Home Telephone Company, backed by financial interests of St. Louis, is attempting to enter the Detroit field. It has filed amended articles of incorporation increasing its capital stock to $6,000,000. The Marquette Construction Company was also organized with a capital of $25,000. St. Louis people identified with the brewing interests there and the Commonwealth Trust Company which is underwriting the $2,000,000 bonds are active in the Home Telephone and the Marquette Construction Company. The Michigan State Telephone Company last year spent $1,000,000 in extensions and improvements. This spring it laid 120 miles of underground conduits in Detroit and is completing arrangements to increase the capacity of the Detroit service by 30,000 telephones. It is also doubling the size of the central exchange building, a six-story structure.

AMERICAN CITIES' COMPANY.—The American Cities' Railway & Light Company has been incorporated at Trenton, N. J., with a nominal capital of $15,000, which will be increased to $27,500,000, divided into $12,500,000 cumulative preferred and $15,000,000 common stock. The new corporation is to take over the Birmingham Railway Light & Power Company, the Memphis Street Railway, the Nashville Railway & Light Company, the Little Rock Railway & Electric Company, the Knoxville Railway & Light Company and the Houston Lighting & Power Company. In exchange for the stock of these six companies the American Cities' Railway & Light Company will issue its entire common stock and $10,000,000 of its preferred stock, reserving $2,500,000 of the latter class for future purposes.

PORTLAND GENERAL ELECTRIC.—Perry, Coffin & Burr, of Boston and New York, are offering $250,000 of the first mortgage 5 per cent gold bonds of the Portland, (Ore.) General Electric Company, of which $4,000,000 have been issued, and of which the present issue is approximately $952,000. The company has $5,048,000 bonds in escrow for extensions. The capital stock is $1,250,000 preferred and $2,500,000 common. The gross income for the year ending May 31, 1906, was $921,940, leaving a surplus after bond interest of $280,505. The company controls the electric light and power business of Portland, which has grown in population from 46,000 in 1890 to 140,000 this year, and which has a magnificent commercial future before it. The electrical business this year has made large and healthy increases.

WESTERN UNION FINANCES.—It is suggested in financial quarters that the Western Union Telegraph Company may probably make a bond issue to meet the necessities of its new work and investment in other corporations, such as the New York Telephone Company. During the last six or seven years it has spent over twelve millions in construction account, purchases of other systems, etc. To be exact, the amount up to the end of June, 1905, was $11,843,754. The company has of its $100,000,000 capital stock authorized made issues of $97,340,606, and has about $20,000,000 in bonds. The stock has been selling around 92, and is steady and strong, but has not gone to par in several years.

WEST INDIA ELECTRIC ANNUAL.—The annual report of the West India Electric Company for the year ended December 31, 1905, shows as follows:

	1905.	1904.	1903.	1902.
Gross	$131,166	$139,762	$138,724	$129,810
Net	63,248	69,628	75,022	64,436
Surplus over charges	28,131	34,242	39,532	29,265

The cost of the property and plant is put at $1,546,745. There are $800,000 stock and $600,000 bonds.

PORTLAND RAILWAY DEAL.—C. T. Loss, of San Francisco, representing Eastern capitalists, has purchased for $500,000 the United Railways of Portland, which controls the valuable Front Street Railway franchise, the Oregon Development Company and the Chamber of Commerce Building, as well as a right of way for an electric railway to connect the outlying towns of the Willamette Valley with Portland.

DIVIDENDS.—The United Gas & Electric Company of New Jersey has declared the regular semi-annual dividend of 2½ per cent on the preferred stock, also an initial dividend of 2 per cent on the common stock of the company, both payable July 16. The directors of the Railway & Light Securities Company have declared a regular semi-annual dividend of $3 per share on the preferred stock, payable August 1.

BELL TELEPHONE GROWTH.—The Bell Telephone Company of Philadelphia and the Delaware & Atlantic Telegraph & Telephone Companies announce a net gain of 3,537 telephones for the month of June, or 32,595 telephones since the first of the year, making a total of 157,385 against 97,283 one year ago. The estimated business for 1906 is 100,000 net gain. The gain for last June was 2,703 telephones.

GUANAJUATO POWER REPORT.—The annual report of the Guanajuato Power & Electric Company for the year ended March 31 shows as follows:

	1906.	1905.	Changes.
Gross	$213,289	$133,477 Inc.	$79,812
Net	147,071	74,430 Inc.	72,641
Surplus over interest	74,193	3,017 Inc.	71,176

ELECTRIC VEHICLE.—It is stated from Philadelphia that the Pennsylvania Electric Vehicle Company is to be dissolved this month, and that no further transfers of stock will be made after July 24. It was one of the survivors of the electric vehicle boom of eight years ago.

DETROIT EDISON ACQUISITION.—The Detroit Edison interests have purchased the capital stock of the Central Heating Company, which heats from a central plant. The North American Company conducted the negotiations, the company owning a large block of Detroit Edison stock.

GENERAL NEWS.

Construction News.

KINGMAN, ARIZ.—Ross H. Blakely, of the Gold Road Power Company, writes that no definite steps have been taken as yet with regard to constructing the proposed power plant.

GLOBE, ARIZ.—Charles M. Clark, who has returned from New York, states that he succeeded in interesting New York capital to develop electrical power from Salt River for distribution in the Globe mining district, and that an engineer would soon be on the ground to start preliminary work.

BLUFF CITY, ARK.—The question of establishing a municipal lighting plant is under consideration here.

ALAMEDA, CAL.—A new generator will soon be installed in the municipal electric lighting plant.

SANTA ANA, CAL.—Plans are being considered by the trustees for the installation of a new system of electric lighting.

GAZELLE, CAL.—The Squaw Creek Mining Company, which owns the famous Dewey mine, ten miles west of Gazelle, has just completed the survey for a power line from Montague to Dunsmuir. The company will build the line for the purpose of serving its own mine and mill, and to supply the towns of Gazelle, Edgewood, Igerna, Weed, Upton, Sisson, Mott and Dunsmuir with light and power. The Squaw Creek Company will purchase electric energy from the Siskiyou Power Company, of Yreka.

SAN FRANCISCO, CAL.—The Pacific States Telephone & Telegraph Company has a large force of men at work in the burned district and is rapidly getting its system into shape. Manager Glass states that from the company's station on Bush street, 1,000 customers are now being served in the burned area. In that station there is a switchboard which has a capacity for serving 5,000 telephones. Difficulty is being experienced in getting the underground wires to work reliably. The conduits containing the wires are in good shape.

MANITOU, COL.—William A. Otis and associates, including G. A. Taff, president Pikes Peak Hydro Electric Company, have decided to soon commence the erection of an electric power plant at Manitou, to cost $300,000. They also propose to expend $200,000 on pipe lines and reservoirs and $500,000 additional in general improvements, and have organized under the name of the Empire Water & Power Company.

WASHINGTON, D. C.—A contract has been awarded to the D'Olier Engineering Company, of Philadelphia, Pa., for furnishing and the installation of an electric pump of 450-kw output, boilers, engines, generators, switchboards, etc., in connection with the Garden City (Kan.) irrigation project. The entire plant is to be operated by electricity from a central power station.

WASHINGTON, D. C.—The Potomac Electric Power Company has filed with the recorder of deeds a deed of trust upon all its property rights and franchises to secure an issue of $7,000,000 in bonds. The object of the issue is to furnish funds with which to purchase additional real estate, construct a new power house and make other improvements. The company has signed contracts for the construction of a new sub-station to be erected between H and I, 14th and 15th streets northwest. The company is also building a new power plant near Bennings.

WASHINGTON, D. C.—Sealed proposals will be received at the office of the United States Reclamation Service, Williston, N. D., until August 14, 1906, for the installation of steam and electric pumping plants, and electric generating and transmission apparatus, including three pumping stations containing centrifugal pumps of 20 and 30 cubic feet per second capacity under heads of from 30 to 50 feet, driven by steam engines and electric motors aggregating 1,200 horsepower; also two 300-kw steam turbine generating units, a 1,000-horse-power boiler plant and accessories, the necessary buildings and 3-mile transmission line, located in the vicinity of Williston, N. D. Particulars may be obtained from the Chief Engineer, U. S. Reclamation Service, Washington, D. C., or from H. A. Storrs, electrical engineer, Williston, N. D.

CARROLTON, GA.—An election will soon be held to vote on the question of issuing bonds for electric lights and other public utilities.

ROME, GA.—All the telephone wires in the business section of the city will be placed underground. J. Epps Brown is manager of the telephone company.

THOMASVILLE, GA.—The city has contracted with the Adams-Bagnall Electric Company, of Cleveland, for a new street lighting system, which will give the city 75 arc lamps instead of 28 as at present, at a cost of $2,356.

ATHENS, GA.—The Athens Electric Company has been granted the right by the Secretary of State to increase its capital stock from $125,000 to $275,000. The company proposes to make a number of improvements to its system in the near future.

JACKSON, GA.—Bids will be received until July 26 by the Mayor and Common Council, for furnishing material and machinery for a water and light plant, including one 66 x 18 boiler, alternator and electrical equipment; meters, transformers and arc lamps; 150-hp. Corliss engine, and pole line material. Address J. B. McCrary, Engineer, Empire Building, Atlanta, Ga.

CARTERSVILLE, GA.—Bids will be received by Paul Gilreath, Mayor, and the Council, for furnishing material and constructing a complete electric light plant, consisting of a 200-kw. alternator and electric equipment, and a 300-hp. Corliss or 4-valve engine, both belted and direct connected; meters, transformers, arc lamps, etc.; two 150-hp. boilers, heaters; feed pumps, etc.

IDAHO FALLS, IDA.—Bids will be received until July 30 at the office of D. G. Platt, city clerk, for constructing a power plant on Snake River.

GRAYVILLE, ILL.—The City Council has appropriated $5,000 for improving the electric light plant.

HEBRON, ILL.—The Farmers' New Era Telephone Company has increased its capital stock from $30,000 to $50,000.

KEWANEE, ILL.—The Lighting & Heating Company has filed a certificate showing an increase in capital stock from $50,000 to $100,000.

GREENFIELD, IND.—The receiver for the Hannah-Jackson Telephone plant in this city has asked the court for direction to sell the plant to the highest bidder.

ANDERSON, IND.—The City Council has granted the Central Union Telephone Company permission to place its wires underground in the central part of the city.

COLUMBUS, IND.—The Commissioners of Bartholomew County have granted a fifty-year franchise to C. S. Ferguson to build an interurban railway through the county.

SHELBYVILLE, IND.—Charles H. Tinall and C. L. Wedding are interested in a new independent telephone company organized here. Articles of incorporation will be filed soon.

FLORA, IND.—The Flora Telephone Company has absorbed the Home Telephone Company, of Flora, and will combine the two plants. Some new equipment will be added and the service extended and improved.

LOGANSPORT, IND.—A mortgage has been filed in this city, Delphi and Lafayette, covering the issue of $1,000,000 in bonds by the Guarantee & Safe Deposit Company, of Philadelphia, to enable the Lafayette & Logansport Traction Company to build its line through Cass, Carroll and Tippecanoe counties.

BLOOMINGTON, IND.—The People's Company, which owned the gas, heating and electric light franchises in this city, has disposed of its property and franchise to a company of Philadelphia capitalists, who will take charge in a short time. It is understood that the new owners will install new machinery and greatly improve the plant.

PRINCETON, IND.—An agreement has been reached with the Council whereby a new franchise will be granted to the Cumberland Telephone Company. The city has its choice of receiving $1,000 for a thirty-year franchise or $2,000 for a thirty-five year franchise. The company obligates itself to install a central energy exchange before July, 1907.

LINTON, IND.—The New Home Telephone Company has sold its business and equipment to the Bell Telephone Company. It is reported that the sale price was $250,000. The officers and directors elected as a result of the sale are as follows: President, John Moss; vice-president, H. F. Hill; secretary and treasurer, W. S. Chapman; auditor, John Uprichard.

MUNCIE, IND.—The City has decided to abandon its municipal street lighting plant and to enter into a contract with a private company to furnish light for the streets, bids for which are now being solicited. Two bids have thus far been received, one from the Indiana Union Traction Company for $65 per arc lamp per year and the other by the Muncie Electric Light Company at $57.50 a year for each lamp. The latter also offered to furnish electricity for street lighting at the rate of 2½ cents per kw-hour.

INDIANAPOLIS, IND.—An ordinance designed to effect a saving of $20,000 a year to this city on street lighting has been introduced in the City Council by the Board of Public Works. The measure provides that railroad companies shall maintain lights at all the street crossings where they have tracks. This ordinance has been drawn in accordance with the specific power granted by the cities and towns act passed by the last Legislature. It is understood that the ordinance will apply to interurban lines on their own track as well as to steam roads.

CLAREMORE, I. T.—This city is considering the question of building a town and interurban street car line. Committees have been appointed and the surveyors have been employed to secure the right of way through the adjoining country.

LONE TREE, IA.—It is reported that this city will have an electric lighting plant in the near future.

BEDFORD, IA.—An election will be held soon for the purpose of voting on granting a franchise to John J. Clark for an electric light plant.

SIDNEY, IA.—The Independent Telephone Company and the People's Mutual Telephone Company have been consolidated. Improvements will be made to the system. T. S. Munsel is in charge.

KEOKUK, IA.—President Roosevelt has signed the bill authorizing the condemnation of lands and easements needed in connection with the proposed development of the water power at Keokuk. Surveys are now in progress looking toward the construction of the proposed dam. Hugh L. Cooper, 60 Wall street, New York, N. Y., is engineer.

TOPEKA, KAN.—The Cherokee & Pittsburg Coal & Mining Company has purchased the plant of the Crawford County Electric Light, Water & Power Company. The price paid for the plant was $15,000.

HUMBOLDT, KAN.—The Humboldt Electric Light Company has made application to the City Council for a franchise to operate an electric system in this city. Arc and incandescent lamps will be used and electricity furnished for motors and fans. The directors are George Amos, C. A. Hess, E. H. Leitzbach, W. A. Byerley and V. G. Shinkle.

OTTAWA, KAN.—Bids are requested by the City of Ottawa, Kan., until July 20, 1906, for rebuilding, extending and improving the municipal water works and electric light and power plant, or portions of said works in accordance with the plans and specifications of the city. The plans and specifications are on file and may be seen at the office of the city clerk, Ottawa, Kan., or at the office of Owen Ford, consulting and supervising engineer, 710 Security Building, St. Louis, Mo. J. H. Bell is city clerk.

PADUCAH, KY.—The joint light committee and the General Council have decided to call for bids for remodeling the city lighting plant.

LOUISVILLE, KY.—G. G. Parker of this city is planning to construct a telephone system from the Great Lakes to the Gulf.

LOUISVILLE, KY.—Mayor Paul C. Barth on June 28 signed the Atherton-Jones ordinance, asking for the sale of a franchise for furnishing heat and electricity to consumers over the entire city. The object of this ordinance is to furnish competition in the lighting business in Louisville. Advertisements will soon be placed for the sale of this franchise.

AMITE CITY, LA.—The citizens have decided to petition Council to call an election to vote on issuing $50,000 bonds for water works, electric lights and a school.

MORGAN, LA.—B. M. and Hugh Young have purchased the electric plant of the Morgan City Improvement Company. The new owners have ordered machinery for a new and much larger plant to replace the present one, and expect to have it in operation in about four months. It is stated that an ice plant will also be installed.

PORTLAND, ME.—The stockholders of the Portland Lighting & Power Company have voted to sell the stock of the company to the syndicate that purchased the Consolidated Electric Light Company.

BIDDEFORD, ME.—The York Light & Heat Company is extending its lines to the Pool, the Pines and Hills Beach, Biddeford summer resorts, and will furnish electricity for lighting these places. About 40 miles of wire will be strung.

ATTLEBORO, MASS.—The Attleboro Electric Company has announced that the price of electricity will be reduced from 20 cents to 15 cents per kw-hour.

BROCKTON, MASS.—The Edison Electric Illuminating Company contemplates installing a 400-hp. boiler in its plant at School and Montello streets this fall.

LEOMINSTER, MASS.—The Leominster Electric Light & Power Company has decided to establish a window circuit, and is prepared to quote special low prices on arc and incandescent lamps for windows, halls and electric sign illumination.

HOLYOKE, MASS.—Arrangements have been completed for operating the paper mill at South Hadley, owned by B. F. Perkins & Son, by electric power. The energy will be supplied by the Holyoke Water Power Company's new plant in this city.

CLINTON, MASS.—The Clinton Gas & Electric Company is extending its line on the Harvard road from Lancaster Center for the purpose of lighting that section of the town. The company has recently installed a day power circuit for fans and motors.

STILL RIVER, MASS.—The Boston Heat, Light & Power Company has decided to purchase the farm of Royal Cheney, of Still River, on which it is proposed to construct gas and electric plants, which will furnish light and power to Clinton, Ayer, Groton, Harvard and Leominster; probable cost of plant $80,000.

BOSTON, MASS.—The Edison Electric Illuminating Company has announced a reduction in charges for electricity to non-contract customers from 8 to 17½ per cent., beginning with July 1. The price has been reduced from 18.2 cents to 15 cents per kw-hour. The rate for power customers has been changed from 18 cents per kw-hour for 15 hours of the demand, to 15 cents per kw-hour for 18 hours of the demand. The contract customers have also received important reductions. The suburban subscribers of the company share in these reductions and they receive electricity upon the same terms as it is supplied to subscribers to the company's service in Boston.

MUSKEGON, MICH.—The Citizens' Telephone Company has increased its capital stock from $50,000 to $100,000.

DETROIT, MICH.—The Home Telephone Company has filed notice of an increase in its capital stock to $6,000,000.

PAW PAW, MICH.—The citizens have voted to appropriate $50,000 for the construction of a hydraulic electric plant for lighting, power and water works purposes.

MARQUETTE, MICH.—The Municipal Light & Power Commission has decided to construct new electric light plants, to be opened in conjunction with the present plant, to cost about $60,000.

DETROIT, MICH.—The Detroit, Flint River & Saginaw Valley Railway Company and the Fenton, Long Lake & Flint Railway Company have been incorporated. The former corporation will build a railroad from Saginaw and Bay City by the way of Flint and will run over the lines of the Fenton, Long Lake & Flint Company to Detroit, making a total of 112 miles of railway. The latter will build a railroad from Fenton to Flint via Long Lake. The officers of the company are J. L. Hudson, president; W. F. Davidson, vice-president and manager; A. G. Bishop, treasurer; D. D. Black, secretary.

OWATONNA, MINN.—The Owatonna Gas & Electric Company has petitioned for a new franchise, and, if secured, will improve the plant. New apparatus will be required.

COLUMBUS, MISS.—The contract for the erection of the new power house on the campus of the Industrial Institute and College has been awarded to D. S. McClanahan.

LABELLE, MO.—H. S. Smith, Mayor, writes that it is proposed to rebuild the electric light plant, recently burned, at a probable cost of $5,000. C. R. Ford, of Labelle, is the engineer.

ST. LOUIS, MO.—The Anheuser-Busch Brewing Association is contemplating the erection of a new power plant to be located at 3000 South Second street. The power house will be two stories high and will cost $30,000.

SEDALIA, MO.—The plants of the Sedalia Gas & Fuel Company and the Sedalia Electric Light & Power Company have been sold to Edward M. Dean & Company, of Grand Rapids, Mich., and E. H. Gay & Company, of Boston, Mass.

OXFORD, NEB.—The citizens have voted to issue bonds for water works and an electric light plant.

SCOTTS BLUFF, NEB.—The Platte Valley Telephone Company has increased its capital stock to $100,000.

CAMDEN, N. J.—Governor Stokes has signed the bill which will enable the city to construct and maintain a municipal light, heat and power plant.

ORANGE, N. J.—The City Council on July 2 rejected the bids of the Public Service Corporation of New Jersey for street lighting and will receive new bids on August 6 on a 1, 3, 5 and 10-year basis, with privilege of erecting poles in the streets. The present contract expires December 1, 1906.

CARLSBAD, NEW MEX.—A. J. Muzzy, of Bristol, Conn., and other eastern associates have acquired a controlling interest in the Carlsbad Public Utilities Company. The company owns and operates the telephone, electric lighting and water systems of the town. The new owners will assume control at an early date.

BATAVIA, N. Y.—The Bell Telephone Company has purchased the plant and system of the Elba Telephone Company.

CANANDAIGUA, N. Y.—The Bell Telephone Company has announced that plans are being made for the construction of a conduit system for placing its wires underground in this village.

ROME, N. Y.—The Central New York Telephone & Telegraph Company will make extensions to its cable system in this place, which will cost about $10,000. Walter L. Nicholson is general manager.

CANANDAIGUA, N. Y.—The Lighting Board, which was appointed for the purpose of investigating the question of establishing a municipal lighting plant, has decided to submit the proposition to the taxpayers, and will soon call a meeting to take the matter up.

BROOKLYN, N. Y.—The Stanley Electric Manufacturing Company has been awarded the contract to furnish the motors to be used in connection with the installation of the high pressure fire service in Brooklyn. The contract represents an expenditure of about $60,000.

NIAGARA FALLS, N. Y.—The International Power Transmission Company has petitioned the Council for a franchise. The company is reported to have a contract with the Niagara, Lockport & Ontario Power Company to take power at the transformer station on the Ernest farm, near the city.

PULASKI, N. Y.—The Board of Village Trustees has entered into a contract with the Pulaski Electric Light & Power Company for lighting the streets of the village for a term of five years. The company is to provide not less than 121 incandescent lamps for a sum not exceeding $1,200 per year.

ONEONTA, N. Y.—The Oneonta & Mohawk Valley Railroad Company, successor to the Oneonta, Cooperstown & Richfield Springs Railway Company, has been authorized by the New York State Railroad Commission to issue a mortgage for $1,800,000; the proceeds of the sale to be used for the reconstruction under the reorganization plan, and for extensions of old lines.

WATERTOWN, N. Y.—Alton D. Adams, of Worcester, Mass., has been employed by the Council to appraise the value of the property of the two lighting companies which are preparing to consolidate, and to make a report which will serve as a basis of agreement or condemnation should the city decide to maintain a municipal lighting plant. Under its contract with the Watertown Electric Light Company the city may terminate its contract for street lighting on one year's notice, taking the company's street lighting equipment, at an appraised or condemnation valuation.

FAYETTEVILLE, N. C.—The Fayetteville Gas & Electric Company has increased its capital stock to $75,000. J. H. T. Martin is president of the company.

CHARLOTTE, N. C.—The Consolidated Construction Company will soon build a new power house and make other additions to its plant preparatory to enlarging its system. The company will install gas engines in place of the steam engines to run the generators.

ROCKINGHAM, N. C.—The Rockingham Power Company has let the contract for the construction of a dam, across the Pee Dee River at Bluitt's Falls where 28,000 hp will be developed, to W. R. Bonsal & Co., of Hamlet, N. C. Transmission lines will be built to Wadesboro, Rockingham and other points.

FARGO, N. D.—Plans are being made by M. E. Beebe for the electric lighting system which is to be installed in the state fair grounds.

GRAND FORKS, N. D.—Dinnie Brothers, of Grand Forks, have secured the contract for constructing a new power house for the Grand Forks Gas & Electric Company. The cost with machinery will be about $40,000.

CLEVELAND, OHIO.—Plans for a central power plant for the new city hall have been approved by Mayor Johnson.

DESHLER, OHIO.—The City Council has granted a franchise to Sumner Cottingham to construct and operate an electric lighting plant in this city.

LIMA, OHIO.—The Central Union Telephone Company is erecting a new telephone exchange in Lima. The building and equipment will cost $25,000.

LOWELLSVILLE, OHIO.—Bids will be received until August 2 by the Board of Electric Light Trustees for furnishing material and installing an electric light plant.

COLUMBUS, OHIO.—The United States Telephone Company is making extensions and improvements to its system in this city, which will cost about $200,000.

CLEVELAND, OHIO.—The Cleveland Telephone Company has placed a contract for the erection of a new telephone exchange on Prospect avenue and East 55th street.

SALEM, OHIO.—The Youngstown & Ohio River Railway, which has leased the Salem Railroad (steam) has commenced the work of converting this line into an electric railway. The road extends from Washingtonville to Salem.

YOUNGSTOWN, OHIO.—The Youngstown & Mineral Ridge Traction Company has applied for a franchise in Mineral Ridge. The company proposes to build from the Ohio works on the outskirts of Youngstown to Mineral Ridge.

CINCINNATI, OHIO.—Plans are being made by the Cincinnati Traction Company to establish a street car service through the village of Bond Hill. The plan is to extend the Avondale line to Bond Hill by the way of Paddock road.

YOUNGSTOWN, OHIO.—The Youngstown Consolidated Gas & Electric Company is preparing to erect a large addition to its power plant on North avenue. The building will be equipped with machinery which will largely increase the capacity of the plant.

TORONTO, OHIO.—The Toronto Electric Light Company has been acquired by the Ely Street Railway Syndicate, of Buffalo, which has acquired the gas and electric plants and street railway properties of the Steubenville Traction & Light Company.

ALLIANCE, OHIO.—The Akron-Alliance Connecting Railway has notified the City Council that it is ready to commence the construction of its line along West Main street, in this city, under a franchise granted several years ago. The company proposes to build a line from Akron to Alliance.

CLEVELAND, OHIO.—The United States Telephone Company will spend $200,000 in improving its system throughout Ohio within the next year. One of the most important improvements will be the building of a direct line from Cleveland to Wheeling, which will afford connections to Pittsburg.

DAYTON, OHIO.—Under the terms of the lease of the Dayton & Western Traction Company to the Indiana, Columbus & Eastern Railway Company, the common stock of the Dayton & Western was increased from $450,000 to $900,000. This increase will be used in making improvements and taking up a small floating debt.

CINCINNATI, OHIO.—The Cincinnati Suburban & Bell Telephone Company is preparing to make important improvements, including the erection of a telephone exchange at Wyoming. The company is also preparing to lay conduits on Delta avenue, from Eastern avenue to Erie avenue, and thence to Grandin Road.

NORWALK, OHIO.—Sherman Culp, of Norwalk, one of the owners of the Sandusky, Norwalk & Mansfield Railway Company, is projecting an electric railway from Shelby to Bucyrus, connecting at Shelby with the road mentioned above and at Bucyrus with the new extension of the Columbus, Delaware & Marion Railway, thus completing a through line from Sandusky to Columbus.

STEUBENVILLE, OHIO.—The property of the Steubenville Traction & Light Company has been transferred to the Ohio Valley Finance Company. The transaction involved about $2,000,000. The new owners have announced that about $150,000 will be spent in improvements, which will be made at once. Van Horn Ely will be president and general manager under the new ownership.

TIFFIN, OHIO.—The syndicate which proposes to establish a large water power plant in the Sandusky River, between Tiffin and Fort Seneca, also proposes to establish an aluminum reducing plant near the power plant, and will also construct an electric railway from Fort Seneca to Fremont for the purpose of handling freight and ore for the aluminum plant. Willis Bacon, of Tiffin, is prominently identified with the project and is securing the water rights for the power plant.

FREMONT, OHIO.—It is stated that the Fremont Yaryan Company has purchased the plant, machinery, franchises and contracts of the Fremont Gas & Electric Company and that the two plants are to be combined at the Yaryan plant, which at present supplies the city with hot water heat and also furnishes a considerable amount of electricity for commercial purposes. It is stated that the consolidated company will improve the city lighting service and put up enclosed arc lamps for street lighting.

CINCINNATI, OHIO.—A manufacturing colony is to be established near the village of Oakley, north of Cincinnati, by several prominent machinery manufacturing concerns. The corporations are the Cincinnati Milling Machine Company, the Bickford Drill Company, the Triumph Electric Company and the Cincinnati Planer Company. These concerns have formed a company known as the Factory Colony Company and have purchased 100 acres of land on the Baltimore & Ohio Railroad, at Oakley, and will locate their plants there. Each plant will cost from $75,000 to $150,000. A plan to establish a central power station and supply heat, light and power for all of the concerns interested is under consideration.

SALEM, N. H.—The Salem Electric Light Company is making improvements and extensions to its system. The company has received a five-year contract to furnish electricity to light Rockingham Park.

TOLO, ORE.—The Condor Water & Power Company is contemplating extending its transmission lines down the valley as far as Eugene. The company is now supplying nearly 2,000 hp in southern Oregon towns and mines.

LA GRANDE, ORE.—The Grande Ronde Electric Company has secured the contract for 30 arc lamps at $8 per lamp per month. This will necessitate the construction of a new system, which, it is stated, the company will complete about September 1. C. H. Crawford is secretary.

ONTARIO, ORE.—The City Council has granted a ten-year franchise to the Idaho Light & Power Company, for an electric light system. The company will secure its power from the Payette River in Idaho, and will supply the towns of Weiser, Payette and New Plymouth, in Idaho, with electricity. The Ontario franchise calls for the completion of the system within one year. T. J. Snyder is president.

HARRISBURG, PA.—The Harrisburg Securities Company has decided to purchase the plant of the Harrisburg Light, Heat & Power Company, and will, it is stated, improve the 9th street plant.

MEADVILLE, PA.—Col. S. B. Dick, H. M. Dickson and M. Fuller, of Meadville, are interested in the rebuilding of the old Bemustown dam, and the establishing there of a large electric power plant, to supply Meadville and vicinity.

HARRISBURG, PA.—It is stated that the Campbellstown & Hummelstown Street Railway will shortly be extended to Campbellstown and Palmyra via Hershey, a distance of eight miles. The line will ultimately be extended from Campbellstown to Bismarck.

HARRISBURG, PA.—Representatives of the Union Traction Company, which controls the systems in Reading and Lebanon, are endeavoring to secure rights of way for an electric line between Myerstown and Womelsdorf, which when built will give through electric railway service between Reading and this city, a distance of nearly 60 miles.

SOUDERTON, PA.—John Bane & Company, of New York, N. Y., have filed their acceptance of the contract to build the electric railway from Trooper to Souderton for the Montgomery Rapid Transit Company, and expect to begin work within two weeks. This line will be 16 miles long, and will form the first part of the line from Norristown to Doylestown.

SHAMOKIN, PA.—The Shamokin & Mount Carmel Electric Railway Company and the Ashland & Centralia Electric Railway Company have been merged into the Shamokin & Mount Carmel Transit Company. A mortgage of $600,000 has been filed to secure a bond issue of like amount. Only $560,000 of the bonds are to be issued at this time, $60,000 to replace a similar issue of the Ashland & Centralia Company, and as much as may be necessary for the Shamokin & Mount Carmel Company. The balance will be used as required to pay off floating indebtedness and for extension of equipment.

PITTSBURG, PA.—Plans are being prepared by the Kuhn interests, which own and contral a number of electric companies and traction systems throughout Fayette and Westmoreland counties and the coke regions, for the establishment of a large central electric power plant at New Haven. These interests now operate a large electric plant at New Haven and it is proposed to greatly enlarge this plant and abandon a series of isolated plants now being operated throughout the coke regions. Recently a score of state charters were secured, covering some companies already organized and operating, and including new companies which asked for township rights. The purpose of these charters was to secure state legal right to connect the various companies controlled by the Kuhn interests with high-tension wires, which are now being erected. Within a year the individual plants will be gradually abandoned, as the central plant at New Haven is enlarged. The ultimate purpose is to have this plant to supply all the power for the entire system. These companies now supply power for the West Penn and Pittsburg, Connellsville & McKeesport traction lines, and furnish light for a score of towns along their routes. Power is also furnished for manufacturing plants in this vicinity.

WAGNER, S. D.—Grimes & Absher are installing an electric lighting plant in the town.

McEWEN, TENN.—Work will commence at once on the construction of an electric light plant in this town. A 30-kw machine will be installed in the factory recently purchased for a power house. L. D. Baker is interested.

FAYETTEVILLE, TENN.—The Board of Mayor and Aldermen of Fayetteville has granted a twenty-year franchise to Capt. Fred. Eslick, who owns the Brady mill property, near Kelso. Work will begin at once, and the current is expected to be ready to be turned on by early fall. The city at present has a contract with the Fayetteville Electric Light & Power Company for lighting the streets.

MEMPHIS, TENN.—The Memphis Telephone Company will increase its capital stock from $1,000,000 to $3,000,000, and to this end has filed a $3,000,000 mortgage in the Shelby County Register's office. The company is also getting out a bond issue, the proceeds of which will be used for improving the local plant. The company also contemplates the erection of a new exchange building at an early date in the eastern part of the city. Harvey Meyers is president.

PALESTINE, TEX.—The Palestine Electric Light Company is making preparations for installing the new arc lighting system, called for in the franchise granted recently.

WACO, TEX.—The County Commissioners are making preparations for installing an electric light plant to supply electricity for lighting the court house and jail. Three engines have been ordered for the plant, and will soon be installed.

PROVO, UTAH.—The citizens are in favor of installing a municipal electric light plant.

SALT LAKE CITY, UTAH.—The City Council has under consideration a better lighting system for the city. The Utah Light & Railway Company has been asked to submit estimates for the installation of incandescent lamps along certain streets at the next meeting. The light committee has recommended that Washington and 25th streets be illuminated from July 1 until October 1, the city to pay the Utah Light & Power Company $35 per night for furnishing the electricity.

LYNCHBURG, VA.—The proposed municipal electric light plant will cost about $50,000. Lamar Lyndon, 80 William street, New York, N. Y., is the consulting engineer. H. L. Shaner is city engineer.

NORFOLK, VA.—Bids will be received until August 4 by Mordecai T. Endicott, Chief Bureau Yards and Docks, Navy Department, Washington, D. C., for 6 water-tube boilers, feed-water heaters, pumps, turbo-alternators, generators, switchboard, etc., for the navy yard, Norfolk, as per specification No. 1496.

RICHMOND, VA.—The Southern Bell Telephone Company has awarded the contract for the construction of its new office building in this city to E. L. Myers, of Norfolk, for $92,874. The company is extending its subways and making many improvements, including a new switchboard with a capacity of 10,000 telephones, at a cost of $200,000.

PETERSBURG, VA.—The new power plant of the Virginia Passenger & Power Company, on the Appomattox River is nearly completed and is expected to be in operation by August 1. The contract for lighting the municipal buildings has been awarded to the company for $900 per year. The present street lighting system will be replaced with new improved arc lamps, if the Board of Aldermen approve the action of the Council of July 3.

MARTINSVILLE, VA.—The new municipal electric light and power plant, erected on Smith's River, two miles south of the town, at a cost of $75,000, is practically completed, and will be ready to supply electricity for light and power as soon as the line is completed to the town. The plant has a capacity of 450 hp. The prices for incandescent lamps range from 20 cents per month per light, for those taking ten or more lamps, to 50 cents per month to those taking a single lamp. Electricity for arc lamps is $2 per month. Meter rates are seven cents per kw-hour. Prices for power range from $20 per hp. per annum, to those taking 75 hp. or more, to $42.50 to those taking 1 hp. per year.

SPOKANE, WASH.—Plans are being made by the Home Telephone Company for the construction of an office building on Howard street, which will cost $60,000.

SPOKANE, WASH.—The Pacific States Telephone & Telegraph Company is making extensive improvements and extensions to its system in this division, which will cost about $500,000. Of this amount $175,000 is being expended for improvements and betterments to the Spokane exchange. Charles W. Reynolds is manager.

CALGARY, CAN.—The City Council has instructed the engineer to prepare estimates and all necessary information for erecting and maintaining a municipal telephone plant. Address Alderman Mitchell.

PRINCE ALBERT, CAN.—E. G. Emple, New York, N. Y.; and A. W. Taylor, of W. S. Weeks & Co., Edmonton, Alberta, have applied for a franchise to build and operate a street railway system in this city. The company will develop its own power if the franchise is granted. L. J. Agnew is mayor.

WINNIPEG, MAN.—H. N. Ruttan, city engineer, writes that the citizens voted June 28 to issue $3,250,000 bonds for developing and transmitting to this city power from Point du Bois on Winnipeg River.

CHATHAM, N. B.—The Town Council has awarded the contract for remodeling the municipal electric light plant to the Westinghouse Electric Manufacturing Company, and the boilers to the Canada Foundry Company.

PORT HOPE, ONT.—The proposition to establish a municipal lighting plant was defeated by the property owners at an election held July 4.

New Industrial Companies.

THE INDEPENDENT TELEPHONE CONSTRUCTION COMPANY, of Topeka, Kan., has been granted a charter with a capital stock of $10,000.

THE EMPIRE ELECTRIC EFFECT COMPANY, of New York, N. Y., has filed articles of incorporation with the Secretary of State with a capital stock of $5,000. The directors are E. C. Wayburn, N. Meyers and Fred A. Hart, of New York.

THE I. C. ENGINE COMPANY, of Croton-on-Hudson, N. Y., has filed articles of incorporation with the Secretary of State with a capital stock of $1,000. The directors are W. E. Powers and Isabelle Testut, of New York, N. Y., and E. E. Pollock, of Glen Ridge, N. J.

THE FISKE COMPANY, of Toledo, Ohio, with a capital stock of $10,000, has been incorporated by Joseph Fiske, E. F. Brough, John F. Kumler, Jr., William Cole and C. D. Koundtz. The company will do an electric construction business and will be managed by Joseph B. Fiske.

THE GOLD CAR HEATING & LIGHTING COMPANY, New York, has been incorporated with a capital stock of $3,000,000. The directors are Edward E. Gold, Richard V. Voges, John C. Dixon, Henry J. Horn, Lucius E. Varney, Ambrose L. O'Shay, of New York, and Edward J. Ronan, of Brooklyn.

THE PACIFIC ELECTRIC & MANUFACTURING COMPANY, Napa, Cal., has been organized to manufacture and sell high-tension switches for indoor and outdoor use, and all high-tension line appliances. Arrangements have been made with Mr. F. G. Baum for the right to manufacture the oil switches and outdoor switches designed by him.

Company Elections.

GEORGETOWN, DEL.—At the annual meeting of the Georgetown Light, Heat & Power Company, held June 30, the following-named officers were elected: L. D. Fuller, president; Charles W. Cullen, secretary; Charles H. Machen, treasurer.

ELLSWORTH, ME.—At a recent meeting of the stockholders of the Bar Harbor & Union River Power Company a new board of directors was chosen and John R. Graham, of Bangor, was elected treasurer and general manager. The control of the company has recently passed into new hands.

New Incorporations.

MONTROSE, COL.—The Montrose Gas, Fuel & Power Company has been incorporated, with a capital of $50,000, by R. H. Washburn and Paul Stevens, of Montrose.

BEDROCK, IDA.—The Bedrock Telephone Company has been organized to build a telephone line from this place to Leland and from there to Kendrick. C. W. Burgess is president.

DALLAS CITY, ILL.—The Western Illinois Electric Power Company has been incorporated, with a capital of $25,000, by J. L. Wolfner, M. J. Dougherty and others.

QUINCY, ILL.—Articles of incorporation have been filed by the Quincy Telephone Company with the Secretary of State with a capital stock of $2,500. The incorporators are F. S. Elliott and others.

CHICAGO, ILL.—Articles of incorporation have been filed with the Secretary of State by the Webster Light & Power Company with a capital stock of $150,000. The incorporators are Alfred E. Bartelme and others.

NEW ATHENS, ILL.—Articles of incorporation have been filed for the New Athens and Hecker Telephone Association with a capital stock of $680. The incorporators are John A. Bartel, Henry Schaeffer and Fred Schanz.

GARY, IND.—The Gary & Hammond Traction Company has been incorporated with a capital stock of $10,000 for the purpose of constructing a system of street and interurban railroads in and between the cities of Hammond, East Chicago and Gary, and other towns in Indiana; also to manufacture and supply electricity and steam for light, heat and power in the towns and cities through which its lines will run. The incorporators are K. K. Knoff, William D. Hayne, William Beepe, Mark Breeden and G. R. Call.

EVANSVILLE, IND.—Articles of incorporation have been filed by the Evansville, Princeton & Vincennes Interurban Railway Company with the Secretary of State with a capital stock of $1,500,000. The purpose of the company is to construct, operate, purchase or lease street and interurban railroads between the cities of Evansville, Princeton and Vincennes and intervening towns and thence to Washington and Pittsburg; also to supply electricity or steam for light, heat and power in the cities and towns through which the lines run. The directors are Henry W. Marshall, Samuel T. Murdock, Robert L. Todd, W. V. Stewart and others.

VINCENNES, IND.—The White River Power Company will soon file articles of incorporation with the Secretary of State. The capital stock is $500,000. The officers are Eugene Rush, of Detroit, Mich., president and general manager; E. H. DeWolfe, of Vincennes, vice-president and assistant general manager; J. T. Small, of Franktort, secretary and chief electrician; L. C. Embry, of Princeton, treasurer and general counsel. The company will begin at once to build a dam on White River at Decker, Ind., and to establish a hydraulic power plant to generate electricity for light, heat and power for all the cities within a radius of seventy-five miles. H. von Schon, a hydraulic engineer of Detroit, Mich., will superintend the work. The company will expend about $1,600,000 on the plant.

CHICKASKA, I. T.—The Chickaska Water Power Company has been incorporated, with a capital of $75,000, by C. E. Cross, Dennis O'Brien and L. E. Wetling, to develop the power of Washita River, for electrical purposes.

PRESTON, IA.—The Preston Telephone Company has filed articles of incorporation with the Secretary of State, with a capital stock of $20,000.

AUGUSTA, ME.—Articles of incorporation have been filed by the New York Electric Storage Battery Company, with a capital stock of $1,000,000.

The incorporators are I. L. Fairbanks, J. Berry, Lewis A. Burleigh, of Augusta.

LANSING, MICH.—Articles of incorporation have been filed with the Secretary of State by the Grand Lodge Telephone Company, with a capital stock of $10,000.

STANDISH, MICH.—The Rifle River Improvement Company has been organized for the purpose of furnishing electricity for lighting and operating mills and factories in Standish, Bay City and Saginaw.

MINNEAPOLIS, MINN.—Articles of incorporation have been filed with the Secretary of State by the Minneapolis Heating & Transmission Company. The purpose of the company is to furnish steam heat from a central plant, and to lease space in its tunnels and shafts to public service corporation for carrying their wires. The company has a capital stock of $50,000. The incorporators are J. S. Porteous, Lewis Miner, J. M. Totten. C. J. Traxler, of Minneapolis, and Edwin H. Cheney, of Chicago, Ill.

CREVE COEUR, MO.—Articles of incorporation have been filed for the Creve Coeur Telephone Company, with a capital stock of $2,000. The company has made an application to the County Court for a franchise.

ST. LOUIS, MO.—The Hillsboro, Kimmswick & Northern Railway Company has been chartered with a capital stock of $300,000. The incorporators are Charles A. Gutke, Anthony F. Furrer, James J. Ring. Charles F. Crane and Lee A. Hall.

LINCOLN, NEB.—The Logan Telephone Company, of Pierce County, has been incorporated with a capital stock of $680.

NEWARK, N. J.—Articles of incorporation have been filed with the Secretary of State by the Peoples' Light & Power Company, with a capital stock of $500,000. The incorporators are Philip W. Jackson, Joseph I. Conlatt and Oliver W. Jackson.

JERSEY CITY, N. J.—The Peoria Light Company has filed articles of incorporation with a capital stock of $3,000,000, for the purpose of constructing electric light, power and gas plants. The incorporators are R. S. Kearney, J. Helmer and W. H. Carey, of Jersey City.

NEW YORK, N. Y.—The North Dakota Independent Telephone Company has been incorporated with a capital stock of $3,000,000. L. J. Coleman is president.

UNADILLA, N. Y.—Articles of incorporation have been filed with the Secretary of State by the Unadilla Valley Telephone Company. The company has a capital stock of $1,500. The directors are: C. D. Cornell, of Rockwell's Mills; A. C. Frate, of Guilford; I. J. Padgett, and O. S. Meader, of South Berlin, and N. S. Pearsall, of Mount Upton.

WEST ASHEVILLE, N. C.—The Buckeye Water Company, of West Asheville, has been incorporated with a capital of $25,000, to supply water, electric lights and power. Julius C. Martin is one of the incorporators.

NEW BERN, N. C.—The New Bern Lighting & Fuel Company has been organized to own and operate gas and electric plants in and near New Bern. The capital stock is $100,000. The incorporators are J. H. T. Martin, of Glenridge, N. Y.; H. D. Wood and A. D. Ward, of New Bern.

BEACH CITY, OHIO.—The Beach City Home Telephone Company, of Stark county, with a capital stock of $5,000, has been incorporated by Joseph Hoy, H. W. Griggs, Otto R. Oberlin, J. W. Rumsey, A. B. Wingate and James Huskopf.

AMESVILLE, OHIO.—The Amesville Telephone Company has filed articles of incorporation with the Secretary of State with a capital stock of $25,000. The incorporators are A. E. Swayne, M. E. Clarke, C. P. Yocum, Hiram Hart and H. S. Hopkins.

PONCA CITY, OKLA.—The Home Telephone Company has filed articles of incorporation with the Secretary of State with a capital stock of $100,000 by R. E. Morrison and others.

READING, PA.—The People's Light Company has filed articles of incorporation with the Secretary of State with a capital stock of $10,000. The incorporators are John H. Keppelman.

CRAWFORD, PA.—Articles of incorporation have been filed with the Secretary of State by the Eastern Crawford Telephone Company, with a capital stock of $20,000. J. D. Downing is president.

HARRISBURG, PA.—The Citizens' Electric Light Company has filed articles of incorporation with the Secretary of State with a capital stock of $10,000. The incorporators are Ernest C. Bruckman and others.

ORANGEBURG, S. C.—The South Carolina Public Service Corporation has been incorporated with a capital stock of $500,000 to build an electric railway from Orangeburg to Ferguson, on the Santee River, a distance of 65 miles. The incorporators are J. T. Timmes, J. C. LaVin, J. A. Bill, George Fleck, Jr., and J. P. Bonney, of Brooklyn; J. A. Graig and others of Orangeburg.

COLLEGE STATION, TEX.—The College Telephone Company has filed articles of incorporation with a capital stock of $2,000. The incorporators are J. C. Eagle and others.

SEATTLE, WASH.—Articles of incorporation have been filed for the Western Electric Company, with a capital stock of $25,000. The incorporators are George E. Wright and others.

FAIRMONT, W. VA.—The Marion Railroad Company has been organized for the purpose of constructing an electric railway between Fairmont and Fairview, a distance of 12 miles. The following officers were elected: T. W. Fleming, of Fairmont, president; J. Y. Hamilton, of Fairview, vice-president; Allison S. Fleming, of Fairmont, secretary and treasurer.

NELSON, B. C.—The St. Marys River Power Company has been formed by Charles Mackey, of Nelson; Robert Campbell, of Moyie: L. Shaw, of Vancouver, and others, to develop electric power on St. Mary's River, and transmit it to Kimberly and its mines, Cranbrook, Ft. Steele, Moyie and its mines, including the St. Eugene. Herman & Burwell, of Vancouver, are the engineers.

Legal.

TELEPHONE NOT A MONOPOLY.—At Syracuse, N. Y., on July 5, Supreme Court Justice W. S. Andrews gave a decision in a local case that a contract between a telephone company and a hotel by which the latter agreed to use the system of the former exclusively and under a certain agreement was not in restraint of trade or in violation of the Sherman anti-trust laws.

OWNERSHIP OF QUOTATIONS.—The rulings as to ownership of quotations have been rather a contradiction, but it is now held that stock quotations are private property even after they have been posted in conspicuous places by the owners or lessees of them and cannot be circulated by those who have not secured the owner's consent. This is the effect of a decision of the Federal Court of Appeals filed by Judge Vandevanter at St. Paul, Minn., on July 9, in the case of the McDermott Commission Company, of Kansas City vs. The Chicago Board of Trade. The case was appealed from the United States Circuit Court for the Western District of Missouri, where the board applied for and received a permanent injunction. This the Appellate Court sustains.

RIGHT TO ACQUIRE PLANT.—A judgment of importance has just been handed down by the Ontario Court of Appeals. It refers to the case of the Ottawa Electric Company vs. the City of Ottawa. Following the acquisition of the Consumers' plant by the city the Ottawa company instituted an action for a declaration that the bylaws passed by the City Council and by which the agreements of purchase, etc., were authorized, were ultra vires. An injunction restraining operation of the plant and other relief was applied for. The case was heard by Chancellor Boyd who, after trial, gave judgment dismissing the action of the Ottawa company The chancellor held that the statute upon which the city's right was founded, giving power to produce, manufacture and use electricity and supply it to others to be used, was to be read distributively and that it was in furtherance of the primary object to acquire the plant of a going concern by which electrical power was supplied to defendants and citizens, leaving it to the future to determine whether it would be of economic expedience to establish works for the production of electric power.

Personal.

MR. E. VAN ETTEN, vice-president of the New York Central Railroad, has been elected a trustee of the Massachusetts Lighting Companies.

MR. JOHN H. HUDSON, JR., has become associated with W. R. Grace & Co., of Valparaiso, Chili, and has left Lima, Peru, during the past month.

MR. ALEX. WYNESS, JR., has resigned as superintendent of the Geneseo, N. Y., Gas & Electric Light Company, and will engage in similar work for a Western syndicate.

MR. E. B. RAYMOND, general superintendent of the General Electric Works at Schenectady, N. Y., underwent a severe operation recently, from which he is now convalescent, so that he has been able to go to Cape Cod for his vacation.

MR. C. E. GROESBECK has been appointed manager of the San Diego Consolidated Gas & Electric Company, of San Diego, Cal. He was formerly at Mobile, Ala. Mr. H. M. Byllesby, vice-president of the company, has been going over the property with him.

MR. EDWARD KLINE, formerly general manager of the Home Telephone Company, of Utica, N. Y., has resigned to become manager of the Home Telephone Company, of Toledo. He succeeds Mr. C. E. Stimson, who goes with the Cuyahoga Company, of Cleveland.

PROF. W. F. DURAND, director of the Department of Mechanical Engineering of Leland Stanford Junior University, has been appointed a member of a commission of three to supervise the reconstruction and rehabilitation of the university buildings, etc., injured by the April earthquake.

MR. WALTER A. PEARSON, formerly electrical engineer for the New York City Railway Company, has been appointed chief engineer for the Electrical Development Company of Ontario, and for the Toronto-Niagara Power Company. Mr. J. W. Putnam, superintendent of lines and feeders in New York, will take charge of the transmission lines, under Mr. Pearson.

MR. E. F. ALEXANDERSON, who has been associated with Mr. Steinmetz in the General Electric Company for some four years past, has sailed this week by a German liner for his native Sweden, where and in Germany he will spend several weeks in rest and recreation, and in studying electrical conditions on the Continent.

MR. GEORGE H. ROWE has opened an office as consulting engineer at 1211 Fisher Building, Chicago. Mr. Rowe is well known as a designer of alternating current apparatus, having been for some time connected with the Western Electric Company, and also for a number of years an instructor in various universities. He will make a specialty of design of apparatus and transmission lines, in which latter branch he had considerable experience while on the Pacific Coast.

M. J. ERSKINE-MURRAY, of Glasgow, Scotland, writes to the London

Times, in vindication of Tesla's priority as an inventor in the line of the rotating magnetic field and the polyphase motor, as well as in regard to high frequency work, wireless telegraphy, and the production of stationary electrical world waves. Mr. Murray's interest in the matter, he writes, is one purely scientific, and his attention was arrested by Mr. Tesla's work while he was preparing a book on wireless telegraphy.

CARROLL-BULTMAN.—Mr. A. T. Carroll, formerly of the New York Edison Company, but now on the technical staff of the purchasing department of the Edison Electric Illuminating Company, of Brooklyn, N. Y., was married on July 4 at St. Sebastian's Church, Woodside, Long Island, to Miss Mary K. Bultman. The ceremony was performed by Rev. Father Gannon, and was followed by a reception at the home of the bride. The happy pair are making an extended trip to Washington, Niagara and other points of interest.

MR. E. C. BRADLEY.—Mr. E. C Bradley, vice-president and director of the Postal Telegraph Cable Company, tendered his resignation at the recent meeting of the Executive Committee, thereby closing a fifteen years' connection with the company. He gave as a reason for his resignation pressure of other business. Mr. George C. Ward, third vice-president, was elected second vice-president, to succeed Mr. Bradley. Charles C. Adams, fourth vice-president, was made third vice-president, and Charles P. Bruch, assistant general manager and assistant secretary, was made fourth vice-president. Thomas E. Fleming was appointed assistant secretary.

BLACKWELL-ROGERS.—Mr. Robert W. Blackwell, of New York, for many years past resident in England, where he has large Anglo-American interests, was married on June 20 at the Parish Church, Hampstead, to Miss L. A. Rogers, sister of Mr. and Mrs. H. F. Parshall. The circle of acquaintance that will receive this news with interest and pleasure is very large on both sides of the Atlantic, Mr. Parshall being also widely known as a representative American on the other side, where he has practiced as a consulting electrical engineer for many years. It is hoped that Mr. and Mrs. Blackwell will soon pay a visit to the United States.

MR. OLAF LANGSTAD has established himself at 13-21 Park Row, New York, to practice as consulting and designing engineer, making a specialty of temperature and pressure regulation in all their branches, especially those branches having to do with power plants, and mechanical processes requiring close regulation of pressure or temperature. The last three years he has been connected with the Davis & Roesch Temperature Controlling Company, and the H. & M. Automatic Regulator Company, as master mechanic and superintendent. He resigned from the latter company in June, but is still looking after the mechanical end, part of the time, until it can make other arrangements.

MR. P. L. FOCARDI, electrical and mechanical engineer, has resigned his position with the J. G. White & Co., with whom he has been for a year and a half, to return to the New Jersey Foundry & Machine Company, of New York City. He is a son of the late G. Focardi, the sculptor and author of popular groups, such as "Oh, You Dirty Boy!" and others well known in the art galleries of Europe. He started work in the electric railway shops in Brooklyn in 1894, passing later into manufacturing shops. As a result of his studies during this time, he was awarded the Cooper medal in 1900, and in 1901 he graduated in the electrical class at Columbia University. Subsequently he took a year's course at the New York Law School. He taught engineering for some time at the American Institute of the City of New York, and has written text for a correspondence school. For the three and a half years after graduation he was with the company which now recalls him.

Educational.

WISCONSIN CHEMICAL ENGINEERING.—The course in chemical engineering, established by the University of Wisconsin during the past year, and full justification has been found in the large demand which has been placed upon the college of engineering for chemical engineers. Requests have been received from industrial establishments in all parts of the country for students having a combined engineering and chemical training, and as many as thirty or forty positions have thus been offered students. The demand for men in the gas industries is especially insistent. The three men receiving the degree of chemical engineer this year have secured positions as follows: Otto L. Kowalke, assistant in chemical engineering, University of Wisconsin; B. B. Burling, experimental department of the Electric Storage Battery Company, Philadelphia, Pa.; A. R. Johnson, assistant in organic chemistry, University of Wisconsin.

Trade Publications.

NILES-BEMENT-POND CO., 111 Broadway, N. Y., has just issued List No. 12 of second-hand metal-working machinery, comprising a very large variety of useful apparatus, including a few dynamos and motors.

TOOLS FOR ELECTRICIANS.—The L. L. Lord Company, 278 Chestnut St., Meadville, Pa., has issued as catalogue No. 4 an illustrated description of special tools for electricians, plumbers, gas and steam fitters, machinists, tinners, blacksmiths, etc.

AMERICAN BLOWER CO., Detroit, Mich., has put forth a dainty little pamphlet on its "A. B. C." system of mechanical draft, of which a view is shown, applied to the Victoria Hotel, New York City. A number of neat illustrations exemplify the use of the system.

FRICTION CLUTCH.—The Williams Electric Machine Company, Akron, Ohio, has issued a well illustrated booklet showing the construction of its friction clutch which consists of a series of interleaved friction discs to multiply the friction surface and power transmitting capacity.

PITTSBURG TRANSFORMER CO., of Pittsburg, Pa., always prompt with neat literature has issued a very tasteful little calendar for July, showing the head of a young girl, capped and ready for a dip in the sea. The circular with it calls attention to the fact that it is the lightning season again.

REPAIR SHOPS.—A description of the car storage and repair shops of the Fort Smith Light & Traction Company, Fort Smith, Ark., which appeared in the *Street Railway Journal*, February 3, 1906, has been reprinted as bulletin No. 3 by H. M. Byllesby & Co., Chicago, the engineers for the construction work on the buildings.

CORLISS ENGINES.—The Allis-Chalmers Company, Milwaukee, Wis., has issued bulletin No. 1503, describing direct-connected Allis-Chalmers-Reliance-Corliss engines of the single-plate gear and double-plate gear types, especially designed for moderate sized plants where it is desired for the generating unit to occupy the minimum of space.

MR. W. H. BOEHM contributed an interesting article recently to "Insurance Engineering" on flywheel explosions. It has now been reproduced by permission in pamphlet form by the Locke Regulator Company, of Salem, Mass., which has added an interesting illustration showing the results of the 20-ton flywheel explosion in the plant of the Mansfield, O., Railway, Light & Power Company last May.

DIRECT-CURRENT GENERATORS.—The Fort Wayne Electric Works issued recently as bulletin No. 1077 a well-prepared discussion of the constructional features of a complete line of small direct-current generators. With the exception of the upper part of the pulley-end pedestal and the pole-piece, the entire iron portion of the machine is one casting, including the base, the field yoke and the commutator-end pedestal. The pole pieces are of the laminated type and are cast into the frame.

HIGH-TENSION SWITCHES.—The Pacific Electric and Manufacturing Company, of Napa, California, has been organized to manufacture and sell high-tension switches and line apparatus, and has made arrangements with Mr. F. G. Baum for the right to make the oil switches and outdoor switches designed by him which have been so remarkably satisfactory on some of the largest high-tension works known. Trade literature on the subject will soon be ready.

EDISON PHONOGRAPHS.—A handsome pamphlet has been issued by the National Phonograph Company, of Orange, N. J., on its Edison coin-slot phonographs. It has a pretty cover showing a woman at the phonograph, while the text illustrates various types of the apparatus and discusses the means of operating the machines on a business basis, to make money. Three of the types are operated by electric current and two by spring motors. The electrics are for direct and alternating current circuits, and for battery current.

"BLISS" is the joyful title of a pamphlet issued by the E. W. Bliss Company, of Brooklyn, N. Y., illustrating and describing in compact form the machinery of the company used for manufacturing electrical parts of apparatus. This line includes power presses, armature teeth cutters, shears, trimming and threading machine rolls, roll drops, dies, etc. Very full details are given, enabling the purchaser at a distance who has not seen any of this excellent apparatus to make a close and exact selection of what he wants. The engravings are admirable also in their clearness.

AUTOMATIC BOILER CUT-OFF VALVE.—Bulletin E of the Lagonda Mfg. Co., Springfield, Ohio, describes in detail a valve which shuts off the steam in a boiler plant automatically in case either a steam header breaks or a tube bursts in the boiler. Although the valve is simple in construction, it performs both of these functions satisfactorily. For instance, when a boiler is shut down, the valve closes automatically and stays closed while the boiler is emptied and cleaned. While steam is being raised, the valve remains closed until the boiler pressure slightly exceeds the pressure in the main, then the valve lifts and steam flows from the boiler into the main.

THE WESCO SUPPLY COMPANY is distributing a very complete net price list in booklet form covering its line of magneto and central energy telephones, also prices on lineman's tools, construction material, exchange equipment and supplies. The cover of this booklet is unique and very attractive, being a reproduction of the emblem of the St. Louis Million Club, which is the equestrian statue of St. Louis, bearing a shield. The Wesco Supply Company has taken advantage of this opportunity to call attention to its trade-mark by compelling St. Louis to bear the "Red Shield," at the same time displaying the motto phrase "To the Front" as emblematic of the spirit of the Wesco Supply Company as well as of St. Louis.

THE CUTTER CO.—The Cutter Electrical & Manufacturing Co., Nineteenth and Hamilton Streets, Philadelphia, Pa., has issued in admirable quarto form, with stout yellow cloth board cover a new edition of its I. T. E. circuit breakers. It illustrates and describes the knife blade types, "Reversite," and other special types, in regard to all of which the fullest data are given, so that the catalogue is in reality a manual on the art of circuit breaker construction. The descriptive text is also supplemented by a number of views of handsome boards on which the Cutter apparatus has been placed. Altogether this is one of the most satisfactory catalogues issued in the electrical industry.

CATALOGUE.—The Wesco Supply Co. announces that its new general electrical catalogue No. 100 is now completed and is being distributed to those actively engaged in electrical trade, either as contractors, dealers, engineers or operators of central stations. This is without doubt one of the most complete catalogues of its kind ever published, containing as it

does complete descriptions with valuable data concerning all modern electrical goods, appliances, devices and specialties, together with much useful information, etc., of immense value to all electrical workers. All buyers of electrical goods are invited to send their name and address, together with their occupation, to the Wesco Supply Company for a copy of this catalogue, which will be sent promptly, express prepaid.

WALL RECEPTACLE, SWITCHES, ETC.—The Stanley-G. I. Electric Mfg. Co., of Pittsfield, Mass., has just issued bulletin No. 608 and circulars No. 778 and No. 785. The bulletin is devoted to the new G. I. flush pocket wall receptacle, which is adapted for use with the standard Edison attaching plugs and has a round door eliminating the objectionable sharp corners of the old style of receptacle. Circular No. 778 is devoted to "Circuit Breakers versus Switches and Fuses" and gives lists and prices of the Stanley-G. I. C-7 circuit breakers. Circular No. 785 is devoted to the "K-9" arc lamp for multiple alternating current circuits suitable for operation on all the standard induction motor voltages, viz., 220, 440, 550. Any of this literature will be gladly sent to anyone making request of the Stanley-G. I. Electric Mfg. Co. for it.

STURTEVANT LITERATURE.—"Condensed Catalogue" No. 135 of Sturtevant blowers, engines, motors, generating sets, economizers, steam heating apparatus, forges, exhaust heads, etc., just issued by the B. F. Sturtevant Co., Boston, Mass., is a remarkably compact publication. It serves as does no other publication of this well-known house to indicate the great variety of its products and the completeness of each distinctive line. The name "Sturtevant" is so generally recognized as synonymous with "blowers" that it is hardly surprising to find nearly half of the catalogue devoted to the many varieties of these machines. Beginning with the high-pressure blowers, capable of creating pressures up to 10 pounds per square inch, there are listed steel pressure blowers for pressures to 16 ounces per square inch, monogram fans operating up to 5 ounces per square inch, steel plate fans with a still less limit of pressure, and disc and propeller fans which seldom operate at pressure above one ounce per square inch. Engines, motors, generators and generating sets occupy a much larger proportion of space than in any previous catalogue published by this company. No fewer than 80 sizes of engines, 42 of standard motors, and 36 sizes of generating sets are illustrated and listed. Forges in a list of 38 sizes, exhaust heads, steam traps and the like find a place in these pages, while heating, ventilating, drying and mechanical draft apparatus in well known types are briefly described. New features in the line of Sturtevant products such as economizers and pneumatic separating systems are also shown.

News of the Trade.

THE STANLEY-G. I. ELECTRIC MFG. CO. has opened a sales office under the management of Mr. C. A. Mann, at 822 New York Life Building, Omaha, Neb.

CHAS. J. BOGUE.—The business of Chas. J. Bogue, 213 Centre street, New York, was incorporated June 16 last, under the name of Chas. J. Bogue Electric Company.

THE MONARCH ELECTRIC MFG. CO. has opened an electric contracting shop at 409 North 19th St., Birmingham, Ala., where it will carry a general stock of electrical supplies. It will be glad to receive catalogues and price lists.

CONSOLIDATION IN SAN FRANCISCO.—The interests of the Century Electric Corporation and the John M. Klein Electrical Company, both well known electrical jobbing houses of San Francisco, have been consolidated under the name of the Century-Klein Electric Company, with temporary offices at 24 Telegraph avenue, Oakland.

THE SPRAGUE ELECTRIC COMPANY announces that it has reopened its office in San Francisco. The old office was destroyed by the earthquake, after which temporary quarters were opened in Oakland. The Sprague Electric Company is now permanently located in the Atlas Building on Mission street, San Francisco, Cal., where all orders from that territory will receive prompt attention.

A PECULIAR USE to which the new waterproof paint now being placed upon the market by the Electric Cable Company, of 17 Battery Place, New York, has been applied is on wooden reels. It has been found that such reels on which wire and cable is wound for shipment sometimes takes up eight or ten pounds of water when exposed to the rain or to damp weather. Considerable annoyance has been caused by the discovery of this fact by the purchaser who weighs the reels upon delivery. The application of this waterproof paint has been found to prevent this absorption of water.

THE STANLEY-G. I. ELECTRIC MFG. CO., of Pittsfield, Mass., has just placed on the market a new and novel type of induction motor made in various sizes up to 7½ h.p. The novel feature of this motor is in having the laminated iron core of the stator freely exposed to the air around its entire periphery. Because of the fact that the frame is held together by means of a riveted construction, the motor will be known as the riveted frame type. The cast-iron ribs which are used with the ordinary induction motors are entirely done away with and thereby all metal is used to much higher efficiency than ever before attained in induction motor sign.

FORGES.—A complete line of forges are built by the B. F. Sturtevant Company, of Boston, Mass., embracing both the portable and stationary types. The former are particularly adapted for local repair work and are operated by hand, by belt or by blast from independent blower. The stationary forges are larger, are provided with either down-draft or up-draft hoods and are substantially built of cast iron, except in the case of the largest sizes, which are heavy steel plate. The tuyeres are carefully designed to prevent clinkering and give the maximum blast. A forge shop equipment usually includes a blower for blast and an exhaust fan for completely removing the smoke.

THE ALBERT & J. M. ANDERSON MFG. COMPANY has recently booked a number of large orders for third rail supports, the latest being for 2,500 for the Metropolitan West Side Elevated Railway Company of Chicago. Ever since the abandonment of the wooden blocks first used on the Chicago Elevated lines, the Anderson third-rail insulators have been installed in very large quantities, and their continued use is suggestive of the satisfactory results attained. Anderson third-rail supports have also been used in Boston since the first installation of the Boston Elevated lines, and the Anderson Company is now filling an order for a new type of third-rail insulator to be used in Boston, and in which the insulation will be Aetna.

FRANKLIN ELECTRIC MFG. CO., of Hartford, Conn., had its second annual conference for the staff of the sales and manufacturing departments during the last week of June, when some good work was accomplished, business sessions being held daily, interspersed with amusement. The annual dinner took place on Thursday, June 28, at the Farmington Country Club, when the menus were printed and shaped to resemble a "Femco" 110-volt lamp complete. Among those participating were Messrs. C. I. Hills, J. Camp, E. D. Redfield, J. W. Morrell, E. B. Hatch, J. A. Butler, P. S. Klees, I. M. Johanson, J. G. D. Morrell, G. O. Curtis, C. N. Thorpe, F. E. Wilson, C. Leonard, P. Howard, H. A. Truitt, P. G. Detweiler, S. O. Richardson, Jr., D. S. Morrell.

THE ELECTRIC CABLE COMPANY, of 17 Battery Place, New York, is now placing on the market for the first time a new waterproofing paint. This material has been brought to the attention of the government authorities at Washington, who have placed a large order with this company for a paint which shall be used on the bottoms of government vessels. The marine department of the New York Central Railroad Company has placed an order for a waterproof paint which shall be applied to the bottom of its tug boats to prevent fouling and corrosive action. It is claimed that this waterproof paint may be made up in any color; and that in addition to its absolute waterproof qualities the colors remain permanent, and the paint will not flake off or crystallize. It has already been successfully used to prevent electrolysis and corrosion on structural steel, stone work, wooden piles, tail bonds, and concrete work. This paint has been made up into a colorless compound for use on stone work and wood work on which the original color is to be preserved.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JULY 3, 1906.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N.Y.]

824,700. FLUSH PLUG AND RECEPTACLE; Charles E. Avery, Jersey City, N. J. App. filed Apr. 18, 1904. The receptacle box is normally closed by a pair of spring doors which may be displaced so as to permit the insertion of a plug having a pair of spring blades thereon. These blades contact with metallic clips supported from a porcelain base.

824,804. AUXILIARY FIRE ALARM SYSTEM; George F. Milliken, Boston, Mass. App. filed Oct. 20, 1905. Has an indicating device by which the number of the sub-station in the auxiliary circuit which has been operated to cause the street box to send in the alarm, will be indicated by a point to be observed conveniently by the fireman responding to the alarm.

824,812. MAGNETIC APPARATUS; Henry R. Plimpton, 2d., Newton Center, Mass. App. filed Feb. 25, 1904. A magnetic device to combine amusement with instruction. A pair of bar magnets have disc-shaped poles, so that they will roll in a lateral direction. In this way their repulsion and attraction to one another are clearly indicated.

824,833. TROLLEY; Joseph Tetlow, Saco, Me. App. filed Nov. 7, 1904. The trolley wheel has a removable tread portion which is normally held in place between the lateral flanges or cheeks by spring pressure. The wheel has ball bearings which are adjustable for wear.

824,834. TROLLEY; Joseph Tetlow, Saco, Me. App. filed Apr. 19, 1905. Relates to modifications of the above, and particularly in the method of supporting the removable tread of the wheel.

824,845. RAIL BOND; Walter G. Clark, Seattle, Wash. App. filed Oct. 13, 1905. A rail bond having a flat fin or plate at each end which is drilled with a multitude of holes. The solder is designed to penetrate through these holes so as to make a perfect joint with the rail.

824,884. FUSE BOX; Howard E. Richards and Robert H. Ramsay, Bellevue, O. App. filed May 15, 1905. The fuse box has a series of terminals, each of which is connected to a fuse wire. A knife blade switch may be moved from one terminal to another so as to throw in any desired fuse wire.

824,887. TRAIN DESPATCHING AND RECORDING SYSTEM; Paul J. Simmen, Chico, Cal. App. filed July 31, 1905. A railroad signal system distinguished mainly by having an indicating board at the train despatcher's office, which is connected with the various block sections along the road by separate metallic circuits. Special contact plates are employed, and the passage of a train causes the circuits to be completed which indicate the position of the train at the despatcher's office. The despatcher may communicate with any train at all times.

824,922. DYNAMO MOTOR; Edward W. Fahl, Shirley, Ind. App. filed Dec. 18, 1905. A special form of gas engine has three cylinders which rotate around a central stationary crank shaft. These cylinders form a fly wheel which is direct connected to an electric generator.

824,953. ELECTRIC TOOL; Paul Schiemann, Dresden, Germany. App. filed Nov. 7, 1904. An electric hammer having sectional windings for the power coils, and means whereby the sections are successively cut out in the operation of the hammer so as to avoid sparking.

824,988. ELECTRIC SIGNALLING DEVICE; Patrick Kennedy, New York, N. Y. App. filed Oct. 13, 1904. A non-interfering fire alarm system having a button which releases a clock train to give the alarm in case no other box of the line is simultaneously sending a signal. If, however, the line is busy, the second alarm will be delayed until the line is clear.

824,989. SIGNALING DEVICE; Patrick Kennedy, New York, N. Y. App. filed Feb. 13, 1905. Relates to features of the above, and particularly the construction of the depressible button. This is in the form of an armature of an iron-clad magnet, so that it is depressible from a distant point as well as directly by the operator.

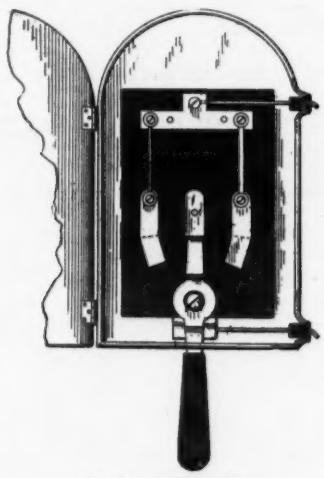
824,990. ELECTRIC SIGNALING DEVICE; Patrick Kennedy, New York, N. Y. App. filed March 23, 1905. Modifications of the above. Particularly with reference to a mechanism by which the movements of the armature of the main or leaf magnet serve to set in motion or arrest a mechanism which acts to break the shunt about the auxiliary magnet.

824,991. ELECTRIC SIGNALING APPARATUS; Patrick Kennedy, New York, N. Y. App. filed Aug. 23, 1905. Relates to details of the depressible button for starting the alarm mechanism into action.

825,055. SIGNALING APPARATUS; John C. Hubinger, Keokuk, Ia. App. filed Sept. 22, 1905. A device for balancing the armature of a signal on one side or the other, so that it is responsible only to selective currents.

825,058. ROTARY ELECTRIC FURNACE; Woolsey McA. Johnson. App. filed Oct. 13, 1903. A form of rotary electric furnace having a bed of fire brick provided with longitudinal ducts in which finely divided conducting material is contained. The entire furnace is rotated in use on rollers, the current being supplied to the copper rings by means of brushes.

825,069. DOWEL PIN FOR ELECTRICAL CONDUITS; Ralph S. Peirce, Chicago, Ill. App. filed Feb. 27, 1905. In order to avoid the defects incident to wooden dowel pins, and also solid metallic ones, the patentee provides a tubular dowel pin which will expand or contract to a slight extent, and which is tapered at both ends. The pin has an ear at its center to prevent its too deep insertion in the conduit tiles.



824,884.—Fuse Box.

825,070. METHOD AND APPARATUS FOR HANGING AERIAL CABLES; Ralph S. Peirce, Chicago, Ill. App. filed Feb. 27, 1905. The cables are enclosed in a split tube, and a special form of suspension having strands which go spirally around said split tube serves to hold the sections thereof firmly together.

825,084. WALL OR SNAP SWITCH; Peter Sorensen, Brooklyn, N. Y. App. filed Nov. 27, 1903. A switch of that type which is turned on or off by successive actuations of a pull rod. A special feature relates to a universal coupling in the operating shaft by which exact alignment of the two sections is made unnecessary.

825,091. ELECTRIC SWITCH; Charles S. Van Nuis, New Brunswick, N. J. App. filed Dec. 10, 1904. The contacts for the knife blade are made of sheet copper strips which are bent around so as to engage the knife blade, and also to receive a copper wire for the terminal connection. The strips are held in place by being embedded in a metal base.

825,092. CIRCUIT BREAKER; Samuel Waterbury, Schenectady, N. Y. App. filed Sept. 23, 1904. Provides a mechanism for securing independence between the two operating devices, so that the closure of the circuit by hand will not interfere with its again automatically opening.

825,142. TROLLEY HARP; Hermann Mangold, Carnot, Pa. App. filed Nov. 10, 1905. A pair of discs are revolubly supported on the harp so as to extend over the top of the wheel and prevent the escape of the conductor therefrom. In passing hangers the discs are laterally displaced.

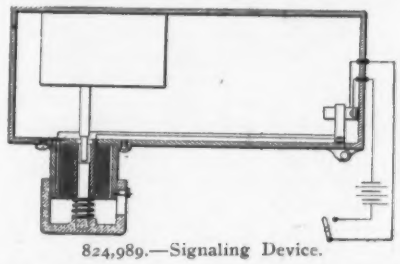
825,144. CIRCUIT BREAKING MECHANISM; Walter S. Mayer, Philadelphia, Pa. App. filed May 17, 1905. Relates to the tripping mechanism of a plurality of circuit breakers arranged in a gang or bank, whereby the tripping of any one circuit breaker will cause the others to be tripped. Provides means whereby any one circuit breaker may be tripped by its own mechanism and the other circuit breakers of the gang or bank tripped by energy derived from the opening movement of the circuit breaker first tripped.

825,182. ELECTRIC LAMP FITTING; Albert J. Bonnella, London, England. App. filed Aug. 7, 1905. A complete design for a lamp and receptacle of a form adapted to imitate a candle. The lamp has a collar which is grasped between spring blades on the holder.

825,199. ELECTRICAL FITTINGS; John Dugdill, Manchester, England. App. filed May 22, 1905. A revoluble wire has a flexible cord wound thereon from which depends the electric lamp. The reel has brushes thereon which contact with stationary discs so as to make the electric circuits with the lamp.

825,204. INSULATOR OF OVERHEAD ELECTRIC CONDUCTORS; Emile Giraud, Paris, France. App. filed Apr. 10, 1905. An electric switch is organized into the construction of the hangers so that the power circuit is broken, and automatically grounded whenever the conductor breaks and falls to the ground.

825,211. RESISTANCE UNIT; Harry E. Heath, Lynn, Mass. App. filed



824,989.—Signaling Device.

July 13, 1905. A flexible sheet of asbestos is wound spirally with a strip of sheet-iron, and the whole is afterwards corrugated or crimped so as to give a more compact disposition.

825,225. SELF-PROPELLED VEHICLE; Hermann Lemp, Lynn, Mass. App. filed Jan. 14, 1904. Relates to a type of vehicle having a gas engine which runs at constant speed to drive an electric generator which in turn drives motors on the wheel axle. Combines a switch for cutting out the series field of the generator with the pedal or lever for controlling the engine speed, whereby the controller of the vehicle is simplified and the number of parts requiring attention from the operator is reduced.

825,227. FLEXIBLE CONDUIT; George A. Lutz, New York, N. Y., and Clarence C. Sibley, Perth Amboy, N. J. App. filed Mar. 14, 1905. In order to prevent a workman from injuring the insulation of a telephone cable by removing the paper winding, the latter is cut or notched at points so spaced as to break apart whenever attempt is made to unwind it.

825,228. ADAPTER FOR LAMP SOCKETS; Norman Marshall, Newton, Mass. App. filed Jan. 28, 1905. The adapter has a conical screw therein which is spring pressed inward so as to bind upon the central threaded stud of a T-H lamp socket and thereafter prevent the withdrawal of the adapter.

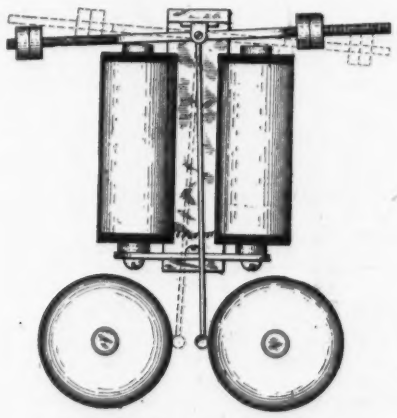
825,236. CABLE OR WIRE HANGER; Richard C. McKiliget, New Orleans, La. App. filed Sept. 27, 1905. Two jaws are connected by a strap which is passed around the trolley conductor, when the two jaws are forced together by a suitable nut, the strap is tightly bent around the conductor to hold the same in place.

825,245. ELECTRIC TRANSMISSION; Robert C. Sayer, Bristol, England. App. filed Jan. 27, 1904. A complete system of construction for express trains in a subway which are adapted to emerge at the surface of the ground opposite the stations. The cars run between a single rail on the roof and one on the floor of the tunnel.

825,251. ELECTRIC SOLDERING IRON; Tycho Van Aller, Schenectady, N. Y. App. filed July 3, 1905. The soldering iron is recessed on its lateral faces and heating coils are contained in such recesses, the whole being surrounded by an insulating sleeve.

825,252. ARMATURE; Frederick M. Vogel, Lynn, Mass. App. filed Aug. 4, 1905. A construction of armature for watt-hour meters adapted to be very light in weight. The core is made of two iron shells which are stamped from sheet metal and which have protuberances to constitute the armature poles.

825,254. COMBINED OUTLET BOX AND LIGHT FIXTURE; Emanuel D. Weber, Easton, Pa. App. filed May 23, 1905. Details of construction of a box inset in the wall and a canopy which fits over said box by which electric connections are conveniently made.



825,055.—Signaling Apparatus.

825,259. SNAP SWITCH; Montraville M. Wood, Schenectady, N. Y. App. filed Nov. 7, 1903. A wall switch having two buttons for making and breaking the circuit by an abrupt movement. The switch blade is impelled by a spring in both directions, and is restrained by a wheel having a pair of stops and which is geared to turn with the switch-operating spindle.

825,272. AUTOMATIC STARTING RHEOSTAT; John L. Hall, Schenectady, N. Y. App. filed Aug. 15, 1902. Construction of rheostat adapted to automatically actuate the switch arm and cut out the resistance when the line switch is closed, and then automatically reset the parts which actuate the switch arm, so that when the latter is released by a no-voltage electric magnet, the device will be ready to operate when the line current is restored.

825,276. AUTOMOBILE; Hermann Lemp, Lynn, Mass. App. filed Jan. 24, 1906. The motor vehicle has a gasolene engine which drives a dynamo to furnish the current for the vehicle motors, but there is no electric regulator in the motor circuit. The regulation is accomplished by throttling the engine which can be made to run slowly enough so that the motors will not turn at all.